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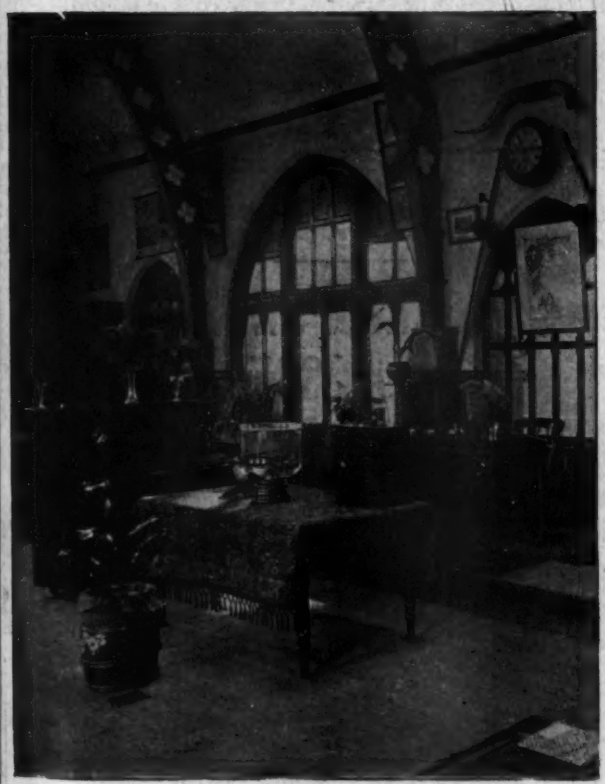

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EDUCATION IN PARLIAMENT—MARCH.

THE educational event in Parliament since last I wrote in these columns has been the Order in Council for a register of teachers. Practically it has been the only educational event. This is to be a sterile session. Let us be thankful for small mercies; we shall get none of a larger size.

More accurately expressed, what I mean is that the recent educational event has been the finding out of the plans for the Teachers' Register—the spying out of the nakedness of the land. Sharp eyes, of interested teachers and classes of teachers, have been turned upon that Order in Council, and nobody felt surprise when a second edition of it was announced. The second edition was not called for by any huge circulation, any rush on the part of purchasers, or the storming of Downing Street by scholastic booksellers anxious to assuage the hunger of teachers to see the charter of their profession. The second edition seems to have been issued because the King's printers had left a semicolon out, and without its proper complement of semicolons no law is law in Britain. The revised version had to be on the table of the House of Commons thirty days before becoming law, and thus it happened that the ratification of the Order in Council was projected into the windy days of March.

Meanwhile, certain people have been considering more than the mere punctuation of the Order, and they find the plans for the register to be anything rather than perfect. I understand that the Board of Education and the Consultative Committee have found that out too. They have been bombarded with protests and riddled with questions. In the House of Commons, Sir John Gorst has amused himself with giving plausible but utterly misleading answers to questions put (in most cases) by bewildered M.P.'s, who hadn't the ghost of a notion of what the register or their questions could be about. "Let us eat, drink, and be merry, for to-morrow we die," Sir John Gorst says to his soul.

Nothing is more amusing to the onlooker than to see Colonel Mark Lockwood, ex-Guardsman, House of Commons dandy, and chairman of the Kitchen Committee, grappling with educational questions. The reason why Colonel Mark takes up the topic is that the secretary of the Incorporated Association of Headmasters is a constituent of his, and thus it happens that Colonel Mark becomes in the House of Commons the guardian and representative of the interests of teachers in secondary schools, or some of them. Painfully he puts a portentous and encyclopedical question. Briefly, quizzically, and erratically Sir John Gorst answers it for him. Then Colonel Mark retires wounded, and pores and puzzles over the matter until his coaches arrive, when he says, "Here, why don't you fellows get a man of your own in the House, like Gray, or Yoxall, or Macnamara? Why indeed?

The Three smile superior at the struggles of Colonel Mark. But he could give them points on the army, and the kitchen arrangements of the House of Commons, as well as the water supply of East London, for he is a water-lord. The Three have rather held their hands over this register matter; they seem to think that it is better to amend it afterwards than to attack it now. Indeed, all possibility of Parliamentary attack was precluded by the rules of the House of Commons. Perhaps the minds of the Three were more at ease because it is understood that the Consultative Committee and the Board of Education are already preparing an amending Order to put certain wrong things right.

The square-set, dogged, saturnine Mr. Bartley joined

in the questioning about the register. How was it going to be determined that a school is "efficient" as a place of service for qualifying for the register? And was it a fact that sixty-four thousand certificated teachers were going to be put on the register free of charge, which would bankrupt the Registration Council? Colonel Mark Lockwood was anxious on this latter point too. Perhaps the Three are silent on the matter all the more because they know that certain antagonists of the elementary school teachers are very displeased with the register indeed. It is to be alphabetic, it is to be comprehensive, and all the certificated teachers are to go on it without cost. These, think the Three no doubt, are substantial gains. However, the thing is not quite perfect from the elementary school teacher's point of view. The dauntless Three have held the bridge manfully, but not with entireness of triumph. When the Education Estimates come on, the House of Commons will have to listen, no doubt, to pleas that "Column B" is invidious, and that any teacher, otherwise qualified, ought to go upon "Column B" whether his experience had been in an elementary school or not. And the kindergarten teachers, and the women "graduates" of Cambridge, and other classes and sections whom the plans for the register do, by inadvertence, exclude, will make so strong a case for revision that the present Order in Council may almost be regarded as merely the foundation of the register that is to be.

The evening school scandal has come in for a good deal of attention. Dr. Macnamara collected statistics about this decaying industry from various School Boards. The Duke of Devonshire said that he "did it a' purpose." Dr. Macnamara then said something about the Duke. Mr. Hutton wanted to know figures about the evening schools, the terms and conditions on which the county councils had authorised them to live out their thin-spun life. With a calm and benevolent mien, Sir John Gorst said that the Board of Education had no such information in their possession. Under Sir John the Board of Education comes in last but one, a good second to the War Office in the departmental donkey-race. Mr. Hutton then inquired—Mr. Hutton acts for the National Education Association—whether Sir John would obtain the missing information. With the mien of a hoary and bearded angel, Sir John said it would be a very expensive business; inquiries would have to be made all over the kingdom, and local bodies would probably refuse to give the information. Whereupon the Opposition cried "Oh, oh!" and many mild and Christian M.P.'s openly thirsted for Sir John's blood. A very pretty piece of comedy indeed!

Mr. Gray has been stirring up Sir John about school attendance. Mr. Yoxall has badgered the War Office about army schoolmasters and remounts. Mr. Whitley, Mr. Yoxall, and Dr. Macnamara deliberately and openly propose to reduce poor Sir John's salary. Sir John works hard—at attending House of Commons divisions (which is the chief duty of a minister nowadays)—and never turns a single white hair. And thus the merry game goes on. It is enough to make my earnest colleagues up in the press gallery rise in their little pews and fling ink-pots at the gamesome Gorst. No other argument is likely to appeal to him but ink on his frosty pow. That is why I spend ink on him here.

No article on Education in Parliament during the month of March would be complete that did not mention the hopes and fears and despairs of an Education Bill this session. We have fluctuated between certainty that there *would* be a Bill and practical assurance that there won't. It now seems certain that there can be no big Bill, and a little one seems hardly worth the while. The *malaise* of Parliament—that don't-care-ness, it-doesn't-matter-a-rap-ness, what's-the-use-ness, and all the other expressions of weariness, disgust, and hopelessness which characterise this session, whether in peace or war—is telling on the prospects for an Education Bill. The prospect varies. The Duke of Devonshire is supposed to be bending his mighty intellect on the problem still, but meantime he has risen in the House of Lords and conveyed to Lord Beauchamp a pretty broad hint that a "Cockerton" Bill would be about the only legislative achievement of the session again. Our Lady of Wisdom, between Sir John Gorst and the Duke, resembles the prima donna between the barber and the ancient husband in the "Marriage of Figaro." I could almost get angry about the condition of the Board of Education, and the fatuous futility of its chiefs; but I won't. The nation doesn't, and why should I?

In place of anger, let us weep. Paralysis, locomotor ataxy, palsy, the falling sickness, hemiplegia—call it what you will—that is what is the matter with the Parliamentary administration of education. Bravely and persistently the Three struggle, like earnest physicians, to regalvanise the patient's limbs and set him in motion. But with a Vice-President who paralyses the Secretary, and a President without a milligramme of quicksilver in him, what hope for any department's health can there be? Scotland waits for her Secondary Education Act till England gets her Education Act, and England waits because the problem is so complex, and the Duke and Sir John are so inept. A mad world, my masters! Come, let us weep together over the woes of our Lady of Education in this land.

And yet, after all, it seems that there is a new prospect of a Bill. The kaleidoscope has turned, the little bits of glass have shifted again. The news comes as I write this for press that the Education Bill is to be introduced before Easter. What it will be, who will introduce it, and all that, are matters that cannot be known before these veridical paragraphs of mine appear in print. It now seems likely, however, that the Duke of Devonshire awoke, in the midst of a Cabinet meeting, and found that his colleagues had decided that there was to be no Education Bill; that thereupon the Duke put his heavy foot down and swore by the turf that a Bill there should be; and that, consequently, there is to be at least the first reading of a Bill—some kind of Bill—Big Bill or "Little-Billee" again. Mr. Balfour's promise of "a very early and very honourable place" for Education this session is to be honoured to the letter, anyhow. But a first reading does not necessarily imply a passing; and as, since that rumour reached me, another Cabinet Council has been held, it is quite on the cards that the kaleidoscope has changed again.

PERULA.

BRITISH MUSEUM

BY MANY HANDS.

"Quot homines, tot sententiæ."

THE following circular, issued to teachers in Queensland by the Education Department of that colony, is like the philosophical system of Bishop Berkeley—it "produces no conviction, and admits of no refutation:"—"CORRESPONDENCE FROM TEACHERS.—The penmanship and punctuation of letters forwarded to this office are often defective. The Minister desires it to be intimated that teachers who have allowed themselves to fall into habits of carelessness must give more heed to punctuation and to the quality of their penmanship. Correspondents who fail in these respects may be called upon to write their letters a second time." Enterprising agents for typewriters will doubtless see in this a promising indication of business, especially if their machines have an automatic punctuating attachment.

Sauce for the Gander.

* * *

AN interesting case is reported by a French journal devoted to the interests of the deaf and dumb, to the effect that two deaf-mutes have passed the examination for the *brevet élémentaire*. The examination is in three parts—written, practical, and oral—which must be passed successively. Failure in any one disqualifies, so that the deaf-mutes must have fared pretty well. In the dictation test they read the words as they were uttered on the lips of their teacher, and in the oral examination they read the questions on the lips of the examiners, their own teacher being allowed to repeat them if not understood at the first pronouncement. In this part of the examination they replied aloud to the questions just as the candidates did whose senses were in a normal condition. The case is curious, and speaks much for the success of the lip-reading method of teaching over the system of finger signs. The test was the more complete that these two candidates had lost both hearing and speech very soon after their birth.

The Dumb to Speak.

* * *

AS we said last month, one frequently has to look abroad in order to know what goes on at home. Another of our French contemporaries publishes the confidences of an English Cabinet minister on his lot. Whoever the minister may be, he was certainly frank about himself.

The Confidences of a Minister.

Since becoming a minister, he says, he knows no pleasure, only trouble. During eleven months of the year he is not free to dispose of his days, and during seven months his nights also are taken. Nine hours out of the twenty-four he passes on the benches of the Commons, nine others in the *fauteuil* of his office! A week of power costs him more speaking, listening, reading, writing, and thinking than a year of ordinary life. Sixty-three journeys he made in one year—three for pleasure, the rest for speech-making; and out of one hundred and fifteen dinners, only seven were among friends. In this strain proceeds the lamentable chronicle of the minister's life, ending with the assertion that the pleasure of becoming minister will not equal the pleasure of ceasing to be one.

Who is this frank and free member of the Cabinet? Can that reference to nine hours per day in the armchair throw any light on the question? Can it be "The Dook"? But no! he is not in the Commons.

Spite of everything, as our French contemporary remarks, the number of candidates for portfolios doesn't diminish, though that for the training colleges does.

* * *

IN all old-established countries the exodus from the rural districts occurs, and in some cases bids fair to become a veritable stampede. This is fast becoming a crucial political and economical question, and many prominent economists and others have occupied themselves in studying the problem that has arisen. Much has been said in England recently on the subject, which Mr. Rider Haggard among others has investigated. So far no efficient method of stopping the depletion of the country districts seems to have been suggested, so perhaps it may not be out of place to mention the action that has recently been taken in the department of Tarn-et-Garonne in France. The stampede is as pronounced in France as elsewhere, and at their wits' end for an explanation and a cure, the authorities have attempted to solve the trouble by taking the *teachers* of the department into their confidence. They have consulted them on the spread of the evil, its importance, the possible means of stopping it, and the part they themselves feel able to play in the case.

Teachers and the Rural Exodus.

* * *

THEY have been asked, in fact—1. What do you think of this new plague, the desertion of the rural districts? 2. What is the extent and importance of the evil? 3. What should be the remedies? 4. What help can you lend in the struggle against this national peril?

Why not Imitate?

This action is a frank acknowledgment of the importance of the rôle played by the rural teacher, on whom, in the last resource, must fall the duty of stemming this ebbing tide of rural population. And we think that the opinions of these French rural teachers will be worth studying by those who, in England, are concerned about what is really a serious danger. For the rural teacher is, after all, the one who is in closest contact with the problem and with the conditions that have tended to produce it, and he, of all people, should be heard in any collection of opinions on the matter. Has it occurred to any one, we wonder, to make among English teachers the inquiry which is being made in Tarn-et-Garonne? Meanwhile we shall watch with interest for the result of the French investigation.

* * *

THE Order in Council which establishes the long-demanded Register of Teachers will cause acute disappointment among some of the teaching bodies concerned. As all our readers are doubtless familiar with the details of the order, we do not need to repeat them. The two points which will specially affect primary teachers are the composition of the Registration Council and the divisional form of the register. It certainly seems strange that the largest and the best-organised teaching association in the country should be represented on the council by one member, just as in the case of comparatively small bodies like the College of Preceptors and the Association of Head Mistresses, not to mention any

The Register of Teachers.

others. A solid body of teachers, nearly fifty thousand strong, and holding in their hands the education of the incomparably greater proportion of the children of school age in the country, seems scantly treated in being adjudged the same representation as a recent body of special interests, and numbering somewhere about a thousand members.

❧ ❧ ❧

THE other point—the form of the register—seems to have been judged unavoidable. The demand for a register has been made for upwards of thirty years, and always for a *single* register, containing the names of all who were entitled to teach, on an equal footing. This single list is provided for by an alphabetical register of all teachers. Differentiation is made by separate columns setting forth qualifications other than those which entitle to teach in an elementary school, and this looks as if there were an intention to register and separate once and for all those teachers dubbed elementary from all others. But in any case registration would involve a statement of qualifications, and such a statement would inevitably have resulted in a differentiation of the people registered, which, under this new Order in Council, takes place at once. The other point already mentioned, that of representation on the Registration Council, seems to us a much more impressive instance of the trend of the Consultative Committee, to whose deliberations this order is due.

And its Effects.

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APROPOS of the Conference to be held at Bristol this year, a quaint note strikes us. Bristol is one of the towns that possessed a "Guild of Kalendars," and one of the very earliest of these guilds, which existed in other towns also. It was a semi-religious corporation, whose members, besides performing certain religious functions, had—in Bristol, at any rate—the charge "to teach young Jews." The teaching was doubtless in the tenets of Christianity, but the fact remains that Bristol, in this quaint way, has a connection with the teaching profession dating back many centuries. Another appropriate link is seen in the sturdily independent character of the Bristolians, who fought for their rights as burghers against kings and barons, and spoke for them in language that was more than independent. A fighting organisation like the N.U.T. could not do better than deliberate in a city whose record of fighting burghers, when rights were menaced, is probably unique in England.

A Bristol Note.

❧ ❧ ❧

FOR the second time *Le Journal des Instituteurs* takes up Mr. Yoxall's articles in THE PRACTICAL TEACHER on Education in France. The opinions of the English expert are not at all to the liking of our French *confrère*, who declares that in his first article Mr. Yoxall had "taken too much as gospel the word of a novelist." The second article, bearing on the distribution of prizes at Bar-le-Duc, is confessed to be better founded, but all the same there is a feeling of irritation running through the long article which is devoted to Mr. Yoxall's remarks and the prize-giving speech of Professor Vladimir Koparski. One result is evident—that the professor's speech has been more closely studied, because of the English comments, than would have been its fate had it fallen, like so many prize-giving discourses, on inattentive ears. And, after all, the only conclusion that the writer arrives at is that, "with all due deference to Mr. Yoxall, perfection is not attained in a day, nor even in a century; and there is an abyss between to-day and the good old times, from every point of view." There is not much disproof in that.

France and Mr. Yoxall.

❧ ❧ ❧

THE reporter of the Congress at Bordeaux, reporting in the *Revue Pédagogique*, a serious and well-conducted monthly, also returns to the charge. He says: "I refuse, however, to admit that Mr. Yoxall could have taken from the Bordeaux Congress the unflattering picture of the French teacher which he drew some few weeks afterwards." Whether Mr. Yoxall did or did not is but little to the point, since the words given above follow the report of the resolution adopted by the Congress, to the following effect: "That social education cannot be efficaciously given in the primary school till the teacher has been enfranchised—(*a*) from the material point of view, by the raising of his remuneration; and (*b*) from the moral point of view, by the full possession, outside school, of all the prerogatives of a free citizen." It seems to us that the question of where the portrait was taken from is a mere detail beside the question as to its truth to nature, which by this resolution seems confessed. But our Gallic comrades will doubtless understand that this give-and-take study is a part of the world-interest in education, and contains nothing that is malicious or detrimental to the objects of the study.

Another Disclaimer.

NOTES FROM THE NORTH.

IN connection with the Leaving Certificate Examinations, opportunity is again to be given to scholars who have received instruction in science in recognised schools, according to a curriculum which extends over at least three years, and provides in every case for experimental work on the part of the pupils, to present themselves for examination on the higher-grade standard only. But candidates for the Intermediate Certificate may be presented to the inspector for approval of their work as to quality and amount. Such approval, combined with a pass in drawing, is to be deemed equivalent to a pass in science on the lower-grade standard.

Leaving Certificate in Science.

In answer to a recent communication by the convener of the Higher Education Committee of the Institute, Dr. Mackay, the following letter with regard to individual passes has been received:—"I am directed to explain that candidates who may pass in individual subjects will be furnished with attestations of having passed in those subjects in which they may have been successful. These attestations will be accepted by the Universities' Joint Board, the Universities of Oxford and Cambridge, and other examining bodies, as exempting *pro tanto* from the examinations which they severally control."

❧ ❧ ❧

A VERY important conference on this subject was recently held in Stirling. Sir John Neilson Cuthbertson, chairman of Glasgow School Board, welcomed the new Code. At first he had felt somewhat alarmed, but since he had come to know it better he had found it to be an improvement on older codes, and notably in the abolition of the specific subjects and standards. As a School Board member, his chief objection to the

Recent Educational Legislation.

changes was the expense involved. The extra expense in Glasgow amounted to at least £20,000 a year.

With regard to the raising of the age limit, he felt that there was a possibility of the labouring classes rebelling at the setting aside the labour certificate; but he was glad to say that in Glasgow, at all events, no such dissatisfaction had been expressed. The raising of the age limit had increased the average attendance of scholars in Glasgow by 3,500, showing that there was a larger number staying on to the higher classes.

The Youthful Offenders Act, he thought, was perhaps the most serious thing that had been brought under his notice as a School Board member. By this Act, the educational, sanitary, and criminal authorities were designed to be mutually helpful. In Glasgow, since the year began, there had been thirty-seven children under fourteen dealt with by the criminal authorities, and what the Department aimed at was to get School Boards to interest themselves in these cases.

* * *

THE recent Act, especially with reference to its exemption provisions, was very fully discussed at the Stirling Conference. Mr. John Henderson, convener of School Attendance Committee under the Edinburgh School Board, referred to these clauses as the safety-valve of the compulsory system. He thought, however, that prudent managers would open it as little as possible, and shut it at every reasonable opportunity. He would not despair of realising a practically universal school attendance up to fourteen years of age. School managers should insist on better attendance. In Edinburgh they had at least 4,000 out of school every day throughout the whole year—that is, about twelve per cent. of the average roll. If we admitted one-half to be unwell or detained by proper causes, in Edinburgh there were 2,000 regular irregulars. It was this residuum that, as a general rule, Boards were called on to exempt. He urged all dealing with this question to watch narrowly where undue exemptions would land us; and while being sympathetic, they should be guided by the head rather than by the heart. Some of the other speakers thought that when clever children had reached the age of eleven or twelve, and had attained all the education that was required for their station in life, there was no use keeping them longer at school. Such ideas belong, I think, to a very long past generation, and I was glad to see that some teachers did not allow this opinion to pass without contradiction. All children, whether bright or dull, must be allowed to have as good an education as possible, and rural Boards are not doing their duty if they do not provide for such. The difficulty is not the teacher's, I feel; it is rather, in many cases, the lack of school accommodation, which is seriously hampering the future education of the country.

Exemption Provisions.

* * *

FORTUNATELY the changes in the recently-issued Code are not numerous. It was hardly to be expected that there would be many important alterations. The Scotch Education Department is gradually getting above the issue of an annual Code. It does its work during the whole year by frequent issue of circulars. It is continually showering circulars of one kind or another, and teachers who have not got these are in danger of losing "grip" with the Department.

One change—an important one to some teachers—is due to recent correspondence between the Department and the Institute. I refer to 118 (4): "As a rule, no pension will be granted to a teacher over 65 years of age on whose behalf application for a pension was not made *before he attained that age*, or within *three months after his attaining it*. Provided that, where application for a pension is made in terms of this article, the Department may, on account of the teacher's special fitness, and on the application of the managers, allow his service to continue for a further limited time."

The New Scotch Code.

Circular 329 is likely to cause alterations next year, but very wisely the Department says that modifications of Articles 43–55, consequent upon Circular 329, are deferred till next issue of the Code.

But what meaneth the withdrawal of the Code, as has been done? Does it point to the changing of these articles, even at the thirteenth hour; or are we to have a Scotch Education Bill in Parliament before Easter?

* * *

CIRCULARS 352 and 353, with accompanying forms, just issued, deal with the question of the training of teachers, and are explanatory of Circular 329. In the former the method of allocating marks for the various subjects by the class teachers is fully explained. It refers particularly to the recording of the attainments of students in subjects which admit of being tested largely by written examinations. An investigation is to be made by the officers of the Department, and other persons specially nominated for the purpose, as to the scope, method, and merits of the teaching of each particular subject, and also as to the manner in which the marks entered on the record sheets are arrived at. The award of certificates to the outgoing students of the present year will be made on the basis of the marks given for the work of the present year, though their position in the class list of the previous year may also, to some extent, be taken into consideration.

Training of Teachers.

Circular 353 refers to the arrangements for testing the attainments of students in training who desire to be recognised as qualified to teach a modern language. The paper to be set is to be the same as that given at the Leaving Certificate Examination in June. There is also to be an oral test for those in their second year of training.

* * *

A SPECIAL meeting of the General Committee of the Institute is to be held to consider the question of raising the unit of representation with a view to making that body smaller and more effective. Already the committee appointed for the purpose have met, and are practically unanimous in agreeing to recommend the raising of the unit. It is to be hoped their recommendations will be approved of by the special meeting.

E.I.S. Topics.

N.B.—*Owing to the withdrawal for alteration of the official Code, it has been necessary to postpone for the present the issue of* **Nelson's Annotated Scotch Code.** *Teachers are, however, recommended to order immediately* FROM THEIR BOOKSELLERS, *as the Annotated Edition will be issued at the shortest possible interval after the appearance of the official publication. The importance of the Circulars issued during the past year renders the possession of this year's Annotated Code indispensable. The "Continuation School Code at a Glance," and the annotations on that Code, will appeal specially to teachers interested in this branch of work. The valuable reference index has been thoroughly revised and improved.*

N.U.T. NOTES.

Bristol, 1902.

EVERY one whose good fortune it was to be present at the morning session of Conference last Easter Tuesday will recollect the delightful speech of the veteran Mr. J. T. Francombe in supporting the cordial invitation given to the Union by his own city. Twenty-eight years previously Conference had met at Bristol, and Mr. Francombe was a young man who "saw visions." One of these was that the day would come when every certificated teacher would be in the Union. Although this has not been realised, Mr. Francombe has had the ineffable satisfaction of seeing the Bristol member-roll increase from eighty-eight to five hundred and thirty-three; and the size and importance of Conference have advanced *pari passu*. Throughout the year, under his experienced leadership, careful and adequate preparations have been made by the numerous committees and sub-committees; and Mr. J. Barnet—possibly the youngest Conference secretary on record, for he is still on the sunny side of thirty—has admirably watched the "co-ordination" of all their labours. Bristol is fortunate in the possession of quite a large number of Unionists known to fame. The rank and file have "backed up" splendidly, and one feels justified in prophesying that the Conference of 1902 will be in the highest degree successful and profitable.

Year by year the number of teachers who make the Conference town the *locale* of their Easter holidays increases, and for the ten days, commencing with March 27th, Bristol's streets and environs will wear a distinctly pedagogic aspect. There is absolutely no mistaking the Conference delegate. The faces and forms of the *habitués* are of course familiar enough, whilst the neophyte betrays himself in various ways. Frequently he carries under his arm huge bundles of literature, carefully collected in the excellent Publishers' Exhibition; sometimes the N.U.T. Report and Admission Ticket are obtrusively displayed; and ever there is the vigilant scrutiny of each passer-by, probably in the hope of meeting a fellow-collegian or acquaintance long lost to view. I would willingly give something to have the sensations of a "First Conference" over again, but it cannot be.

The Opening Day.

EASTER 1902 will witness a notable innovation in the arrangements for the opening day. For some years past it has been felt that the inaugural session was lengthy to the point of being wearisome; for crowded into it were the public reception, the reception of deputations, the President's address, and other items. Frequently the session lasted over four hours, and there was a constant exodus as the afternoon wore on. This year *nous avons changé tout cela*. The Lord Mayor of Bristol and other representatives of the city will attend and welcome the Conference at 11 a.m. on Easter Monday; and after they have been duly thanked, the President-Elect will be installed. Conference will then gratefully recognise the valuable services of Mr. J. F. Blacker, who, before replying to a vote of thanks, will receive the President's badge at the hands of Mrs. Allen Croft. An ovation awaits Mr. Blacker, for he has been one of the best Presidents I have known. The deputations from Scotland, Ireland, and the Continent will next be welcomed, and with brief addresses from a representative of each nationality the session will close.

At the afternoon session, timed to commence at 2.30, the President's address will be delivered. Penning these notes a fortnight before Easter, I feel at liberty to state that this address will probably be found to possess at least one quality—it will be commendably brief. Mr. Hector Tomkins, the popular and indefatigable President of the Nottingham Association, will propose a vote of thanks to his fellow-townsman, whilst Mr. Frank Goldstone, the talented Vice-President of the N.F.A.T., will second, as a representative class teacher. The result of the election for Vice-President will be declared at the termination of the session.

Public Sessions.

TIME was when the responsibility for choice of subjects to be discussed rested with the Executive. Since 1899, however, a plebiscite of the local associations has determined the order of business, and the general result has been satisfactory. On Easter Tuesday the Educational System has, naturally, pride of place; and if H.M. Government requires a lead, it is certain to be forthcoming in the resolutions accepted by Conference. Tenure, Examinations of Scholars, and Attendance at School are also on the orders of the day; but it is extremely likely that not one of these will be reached. *Nous verrons!*

At the fourth public session, Discipline in Schools, Salaries of Teachers, Evening and Higher Grade Schools, and Staffing of Schools provide the bill of fare, though it is quite possible the standing orders may be suspended to consider any urgent matters that have arisen since the publication of the agenda. At twelve noon on Wednesday the votes of thanks to the zealous and energetic local enthusiasts will be moved from the chair; and after representative Bristol men and women have acknowledged the Conference's thanks, the illuminated address—or "leaving certificate," as Mr. Marshall Jackman wittily termed it—adopted at the first session, will be presented to Mr. J. F. Blacker.

Private Sessions.

THE purely domestic business of the Union will be taken on Tuesday afternoon and Thursday morning. There is little of a "burning" nature on the agenda for either session; and if the financial statements are disposed of in reasonable time, the whole of the items on the programme can be dealt with. Last year I expressed the hope that "the time for base innuendo and below-the-belt insinuations terminated with the nineteenth century," and Great Yarmouth was delightfully free from such distressing incidents. Conference must always retain a tight grip on the purse-strings of the Union, but financial policy can be thoroughly debated without any reflections on the personal probity of the members of the Executive.

After the more or less "stock" opening business of the private sessions has been cleared off, motions respecting *The Schoolmaster* will be considered. In certain quarters a strong feeling exists that the "Organ of the Union" should be the sole property of the Union, and much can be urged in support of the principle. Four or five years ago Conference sanctioned, almost unanimously, the adoption of an agreement between the Executive (on behalf of the Union) and *The Schoolmaster* directors; and at the time it was certainly thought that advantageous terms had been secured for the Union. Doubtless, the influential metropolitan associations which desire to see this agreement terminated will be prepared

with adequate and excellent reasons for their action. Confidential reports, representation at Conference, and election of Executive will be discussed after the "Organ of the Union." These are "hardy annuals," but none the less interesting and important.

* * *

THE ardent Conference worker need not have a dull moment during the whole of Easter week; for apart from and outside the Conference sessions proper, there is an almost endless variety of meetings, functions, and diversions to attract attention. On the evening of Easter Monday, that particularly useful branch of Union organisation, the Teachers' Provident Society, will hold its annual meeting, and the members felicitate one another on a fine year's work. The class teachers will also foregather, and a "record" assembly is assured; for never before in the Union's history has its President been able to address them as "fellow class teachers." A reception by the Lord Mayor at the Victoria Rooms will be a fitting wind-up to an eventful day.

The "Side Shows."

The "Temperance Breakfast" opens the ball on Tuesday morning, and the Conference Dinner follows in due course on the evening of the same day. College reunions and the Ladies' At Home fill the bill on Wednesday evening, whilst the various meetings of the B. and O. Funds and the Conference Ball provide the *pièces de resistance* for Thursday. Excursions are specially set down for Wednesday afternoon and Friday, but practically they will be going on all the week. The visitor to Bristol who has anything but "a thoroughly good time" will be himself to blame, for a finer series of outings has never been organised within living memory.

* * *

THE appearance of these "Notes" will synchronise with important changes in the *personnel* of the Union's officers, and a brief reference to those giving up the seals may prove not uninteresting. The retiring President, Mr. J. F. Blacker, I have already referred to as "one of the best Presidents I have known." As the Chairman of the Executive, he has won golden opinions for his eminent fairness, perfect courtesy, and invariable good temper; whilst, on the few occasions when he has acted as the Union's spokesman, he has said the right things in the best of all possible ways. Throughout the year, he has been ever ready to sacrifice personal comfort and leisured ease on behalf of his fellow-teachers, and will have the satisfaction of stepping from the Union's chair with the knowledge that he leaves not an enemy behind, despite the vigorous and straightforward manner of voicing his own convictions.

The Officers of the Union.

The ex-Presidents are a notable trio, whose names are household words. With the greatest joy, the Executive saw Mr. Robt. Wild return to Russell Square, after a month's absence, for it could ill afford to lose one of its "Grand Old Men." For years I literally "sat at his feet" as vice-chairman of the Education Committee, and his noble ideals, courtly phrases, and incessant labours had an influence on all the younger men. For much in the way of timely counsel and sympathetic encouragement I am indebted to Mr. Wild, and many Unionists are in the same enviable position. Mr. Marshall Jackman, the youngest ex-President, has—although the feat seems almost impossible—added to his great reputation for skilful leadership during the past year. Disdaining to rest on his well-won laurels, he has struck a new vein, the *fons et origo* of which are Dr. Gow's sneering reference to "bounty-fed Board schools." The time is not ripe for a fuller reference to this phase of his work; but the skill with which he marshals his facts, and the steady determination with which he pursues his righteous ends, remain the admiration of his Executive colleagues. Of Mr. Waddington, whose term of ex-Presidency has now expired, it is not easy to write anything new. By common consent, he is our ablest debater, as well as our most far-seeing and courageous fellow-member. He has "specialised" on almost every branch of Union activity, and were I in "a tight corner" I would sooner have him as my champion than any other of the many able men I am privileged to know. A torrent of verbosity cannot add to such appreciation and confidence.

Mr. Hamilton, as treasurer, goes on apparently "for ever," and the Union is blessed in the retention of his services. Eminently trustworthy, kindly, and genial, he is the ideal man to have charge of the Union's funds

A. C.

MENTAL FATIGUE.

BY JOHN ADAMS, M.A., B.SC.

FATIGUE is one of those words that are very hard to define because they are so easily understood. But many people who have no difficulty in naming their state after weeding for a couple of hours under a hot sun are not quite sure whether they understand what is meant by mental fatigue; and, unusual though it is, scientific writers openly share this uncertainty of the plain man. Perhaps the learned are not quite prepared to admit their uncertainty, but the inconsistencies of their results save them this trouble.

The point in dispute is whether there are two kinds of fatigue—muscular and mental—or if the state of being fatigued is essentially the same, whether induced by head-work or hand-work. The balance of evidence is at present in favour of the identity of all fatigue, whatever its source. The theory that fatigue is caused by the production of certain poisonous substances in the blood is not of vital importance to teachers; though even teachers may be permitted to be interested in the experiments in which a healthy, well-rested animal is inoculated with fatigue by injection with blood from the veins of a fatigued animal, and this even after the blood has been beaten up in the air to rid it of the carbonic acid.

We are more concerned with the results of the investigations into the fatigue-producing powers of the various school subjects. The following two tables profess to represent the relative powers of the subjects named as fatigue-producers. The first table is the result of the experiments of Ludwig Wagner:—

Mathematics	100	Arithmetic	82
Latin	91	French	82
Greek	90	German (mother tongue)	82
Gymnastics	90	Nature Study	80
History	85	Drawing	77
Geography	85	Religion	77

What one likes about this table is its definiteness. There is no uncertainty about it. All that it requires for complete conviction is a decimal point or two. Unfortunately it does not stand alone, and its rivals do not do all that might be expected in the way of support. Ferdinand Kemsies, following a different line of investigation, arrives at a different order of merit among the fatigue-

producers. His statement lacks the arithmetical buttresses, for he contents himself with a mere arrangement in descending order of power in producing fatigue.

1. Gymnastics.
2. Mathematics.
3. Languages (not mother tongue).
4. Religion.
5. German (mother tongue).
6. Nature Knowledge and Geography.
7. History.
8. Singing and Drawing.

Teachers naturally want to know how these remarkable results have been obtained. It raises our confidence in them when we know that the investigaters used instruments—one might almost write machines.

Wagner's instrument is very simple, though its name would hardly suggest that. It is called the *æsthesiometer*, but consists of nothing more formidable than a pair of compasses, known, from their use in physiology, as "touch compasses." If the points of a pair of slightly-opened compasses be applied at the same moment to the tip of the forefinger, we are able to distinguish them as two separate points if they are $\frac{1}{16}$ or even $\frac{1}{18}$ of an inch apart. If applied to other parts of the body, the points may have to be much wider apart before we can recognise them as separate. If applied to our back, the points have to be over two inches apart. Not only does the distance between the points vary with the different parts of the body, but with the different occasions on which the test is made. To distinguish the points when close together requires a considerable amount of attention, and this attention varies with our state of fatigue. When we are tired, we cannot attend so well; and the compasses must be opened wider in our tired state. If, then, we fix the amount of opening required when we are fresh, we have a standard by which we can compare the various degrees of fatigue. Griesbach was the first to make use of this instrument. His results were at first received with great respect, but recent investigators are less inclined to accept them.

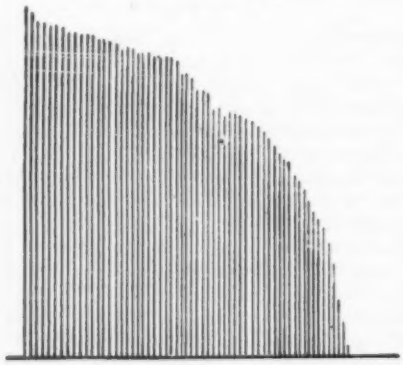

Fig. 1.

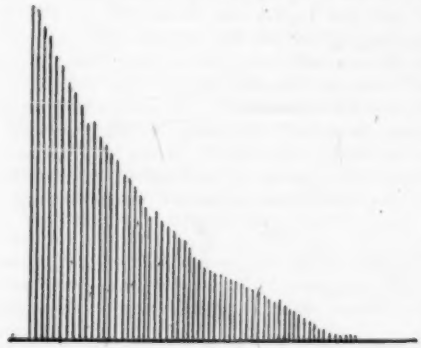

Fig. 2.

The other instrument owes its name—the *ergograph*—and its application to the problem of mental fatigue, to Professor Mosso of Turin. Like the æsthesiometer, it was known in physiology before it was used in psychology. It is indeed but a modification of Helmholtz' myograph, or machine for testing the amount of work done by muscles. It consists essentially of a flat board, to which the arm of the subject is strapped down, and a sort of metal glove at the end of the board, into which the subject's fingers are placed, all except the middle finger, which is fitted with a broad metal ring, to which is attached a cord that passes over a pulley at the end of the table, and supports a weight. The test consists in pulling up the weight by bending the middle finger at stated intervals—say, once every two seconds. This goes on till the muscle refuses to respond to the will of the subject. Attached to the instrument is the recording drum, without which no such piece of apparatus could face the world.

Ergographic result-sheets give us many interesting bits of information. It appears that we have all our own peculiar ways of getting tired, and that these ways are constant; that is, if we are tested for fatigue *under the same conditions* at a considerable interval of time, the ergographic curve remains the same. There are two main kinds of such curves. Fig. 1 represents a typical curve of the convex kind, while Fig. 2 shows up a concave curve.

It is clear that in both cases the subject very soon *begins* to get tired, and in both cases the actual length of time it takes to get quite tired is about the same. But obviously the amount of work done by a man of a convex fatigue curve is greatly in excess of that done in the same time by a man of a concave curve. The standard of work done is usually taken as the energy required to raise one kilogramme through one metre of space, this unit being known as a kilogrammeter. The subject may sham by doing less work than he can, but he cannot pretend to do more than his physical power admits; for, after a certain period, the will absolutely refuses to do a single stroke more. Thus we have a perfectly accurate maximum, which may by-and-by have a commercial importance. It does not exhaust even a slow imagination to picture the time when all manual labourers will have to submit to an initial ergographic test before being employed, and will have their wages fixed accordingly.

There is one experiment with the ergograph that deserves special attention. It is found to be possible to arrange the instrument so that only one muscle of the middle finger is allowed to work. An electric battery is so placed that it may be used to stimulate this isolated muscle at the will of the man who conducts the experiment. The subject is made to work the muscle till it ceases to respond to the will. At the very moment that motion ceases, the operator applies the battery, so as to keep up the regular contraction of the muscle without the help of the subject. After a little while the subject is again called upon to move the muscle without the aid of the battery. The interesting thing is that he can begin the motion just as if he had been resting.

Next Month:

REGIONAL GEOGRAPHY.

By J. Berenice Reynolds, B.A.

The change from will to electricity and back again has been made several times in succession without allowing the finger to cease moving, even for a single contraction. Notice what this means. It is not the muscle that is tired, but the will. The origin of the fatigue, in other words, seems to be central, not local.

Every hard student is quite prepared for this result. After an evening of hard study he is accustomed to go to bed with all the symptoms of great physical fatigue. For the teacher this is a very practical point. It is still not uncommon to find some who cling to the tradition that gymnastic exercises are the best means of dispelling fatigue. We have seen that experiment proves the very opposite. Common sense has come to the same conclusion as the experimenters. The combination of the hard-reading and the hard-rowing man is no longer the ideal of the universities.

Yet the belief that gymnastics drives off mental fatigue is too generally held, and held by too sensible people, to be entirely false. The truth underlying it is that a few bodily motions, such as raising the arms and waving them about, do dissipate the attention, and therefore rest the central organs, just as the will rested while the electricity looked after the motions of the finger. But in the work of gymnastics proper much has to be done by the central organs in the way of co-ordinating movements, and there is consequently no rest.

One of the venerable maxims of the schoolroom is that a change of work is as good as a rest. Here, again, there is enough truth to justify the saying, but enough error to make it dangerous. Two things, in fact, are frequently confounded with each other. A child may be fatigued by a subject, or he may be only bored. To be tired of a subject is not quite the same thing as to be tired by it. *Ennui* and weariness are different things. A child who is bored with a subject has very often a great deal of energy available for other things; in fact, the cause of *ennui* is not unfrequently excess of energy that can find no congenial outlet. A very practical distinction between fatigue and *ennui* is that change of subject may remove the latter, while nothing but rest can remove the former.

In all questions of over-pressure there should be a clear line drawn between fatigue and over-fatigue. It is right that children should be fatigued after a day's work, even if that work has been of the most interesting. Indeed, the more interesting the work, the more intense the fatigue, because of the amount of energy pleasantly but lavishly expended. A radical defect of the experiments that led to the tables at the beginning of this article is the neglect of the character of the teacher. We could all point to teachers of mathematics whose pupils would not reach the 100 per cent. of fatigue, while there are teachers of drawing who manage to extract more than their legitimate 77 per cent. of weariness. He is not precisely a wise teacher who boasts that he sends away his class as fresh as it came in. Where classes pass from master to master during the course of the day, it is the weak teacher, not the weak subject, that complains at the limp state in which the pupils are passed on from certain classes.

If the pupil does not recover from his fatigue in the ordinary course of life, he is being over-pressed. Every time that special means have to be taken to get rid of weariness, there has been over-fatigue.

Every P.T. reader should see **THE PRACTICAL TEACHER'S ART MONTHLY for April.** *For List of Contents, see page 2 of Cover.*

RURAL EDUCATION IN FRANCE.

VOLUME VII. OF SPECIAL REPORTS ON EDUCATIONAL SUBJECTS.

"*In tenui labor at tenuis non gloria.*"

THE above line from the fourth *Georgic*, which Dryden aptly translates, "Slight is the subject, but the praise not small," might well be used in connection with this extremely interesting and well-written book of reports, for which we personally feel deeply indebted to Mr. Cloudesley Brereton and Mr. J. C. Medd, and especially to the former, who certainly possesses that most scribely of gifts—namely, the *curiosa felicitas*—which enables him to tell the tale of French rural education in such pleasing vein as to appeal to that prince of dullards in respect to education, the man in the street. We have read the volume with unflagging interest when the clock has in vain said "Bed!" and we commend it to practical teachers as wise, human, and level-headed far beyond the wont of even Mr. Sadler's reports. The passages we have marked for quotation are so numerous that we should require a whole PRACTICAL TEACHER to set them out, so we intend just to go on in a fugitive way until the editor's blue pencil cries "Hold, enough!"

Mr. Sadler's Contribution.—However slender may have been the pedagogic equipment of the Director of Special Inquiries when Mr. Acland called him to his newly-created post, he is to-day a learned exponent of the unrespected science of teaching, as witness his introductory letter to Sir George Kekewich, who must view his coadjutor with unqualified satisfaction. Says he: "Education is a much greater and more difficult thing than the mere imparting of intellectual instruction. A good school makes the children think; it makes them interested in what lies around them; it makes them ask questions; it makes them keen. It does not cram them with undigested knowledge. It trains them to think for themselves.....It aims at producing not only self-reliance, but self-control and readiness to sacrifice selfish interests to duty." And so on through four pages of excellent doctrine worthy of "the missionary enthusiasm for national education" which he ascribes to republican France, and which he is doing his best to make current in slow-moving England.

The Rural Schools of North-West France.—This is Mr. Brereton's description of his treatise, but he might well have deleted "rural" and "north-west," for he gives a most convincing insight into the characteristics of French popular schools as a whole.

The Spade-Workers.—It is to the much-despised Third Republic that the author gives the credit for the excellent school provision now obtaining across the Channel. "When the history of the first thirty years of the Third Republic is written, it will probably be admitted on all sides that its most permanent and enduring work is the reorganisation and re-creation of the system of primary education in France." This work he sums up "under the heads of free education, compulsory attendance and laicisation of the schools, simplification and adjustment of the cost of education between the three contracting parties—the state, department, and commune—generalisation of primary education by the construction or maintenance of a public school in every village, with a marked improvement in school furniture and equipment, thanks to the generosity of the central authorities; teachers' salaries raised, and teachers themselves paid by the state, while everywhere training colleges have been provided in abundance. At the same time, the instruction given has been rendered at once democratic by the teaching of civics and *la morale*, and practical by the introduction of manual training and agriculture; and, lastly, the higher primary school, which is the most natural crown to a primary education, has been successfully re-established."

The Inspectorate.—"In England the primary inspectors are appointed by the president of the Board of Education; in France the inspectors are chosen by a system of examination." And a theoretical knowledge of pedagogics as well as practical skill in examining must be possessed in an eminent degree before the candidate can hope to pass. A

list of subjects, and some examination questions, are given in the report. They bear out this statement very effectually. In 1899, out of 229 candidates, only 22 passed! Salaries range from 3,000 to 5,000 francs per annum.

The Teacher.—"Teachers generally commence with the position of assistant in the country. They next move into the town schools as assistants; after that they return to the country as head of a school, from whence the best go back to preside over the large town schools."

Religious Difficulty.—This is usually very acute, and in the country districts the poor pedagogue is *anathema maranatha* to the curé and the *bon Catholique*. Some teachers found themselves "boycotted." The local grocer and provision merchant refused to serve them. "Si vous envoyez mon neveu ou ma nièce à l'école sans Dieu, n'attendez rien de moi; une congrégation sera mon héritière," said a rich aunt to her relations, and the parish council of the place passed a resolution deploring "être obligé par une loi scélérate à entretenir une école de perdition." It is pleasant to note that they are improving. One teacher was proud of the fact that for the first time in fifteen years the curé came to his prize-giving.

Promotion is not rapid, so that there has been a notable decrease in the number of candidates for the office of teacher. It is the peasant proprietor, and men of like standing, whose children become teachers, and it is the primary school from which the vast majority of the candidates come. Salaries run from 1,000 to 2,000 francs for men, and from 1,000 to 1,600 francs for women. A house is always provided, and there are various extraneous tasks open to the teacher during his out-of-school time, some of which are compulsory but carry a salary. For example, the schoolmaster is the recognised secretary of the *maire*. *Per contra*, the teacher often conducts the evening continuation school for nothing, and even, at times, pays for the heating and lighting out of his private purse, and spends much of his time in managing old boys' clubs and other social movements, so that he has practically no leisure time worth speaking of.

Pensions.—Retirement may be claimed at fifty-five if the claimant has served twenty-five years, and he gets fifty per cent. of his average salary, which must not, however, be less than 600 francs for a man, and 500 for a woman.

Accidents.—Until about two years ago the law regarded every teacher as pecuniarily liable for any injury sustained by a pupil whilst on the school premises, even if the result of the purest accident. This was changed, in 1899, to responsibility only when the teacher had been negligent or imprudent.

N.U.T. of French Teachers.—Until recently the authorities have discouraged federation. A decisive step was, however, taken two years ago at Laon, where a congress for all the associations of teachers was permitted, and now *amicales* are springing up in every department; but the subjects of discussion are limited to questions of school management, so that the *amicales* bear but a passing resemblance to the associations of the English N.U.T.

History in the Kindergarten.—A kindergarten teacher boasted that she taught history to her children, and by request told them the story of Jeanne d'Arc. When the story came to an end, the children seemed discontented, and at last one of them said: "And the sheep, what happened to them?" The children, being of the country, knew what a sheep was, but had utterly failed to take in the rest of the so-called history lesson.

School Provision run mad.—Each commune must either have a separate school or join with another commune for this purpose. Some village hamlet fathers are keen upon the possession of a school at whatever cost. I myself heard of one small commune of only eighty inhabitants which had built and furnished a school which is attended by only four pupils! I was told of another, with a school population of five, which spent 20,000 francs on putting up a school. A third commune, with a school population of ten, would have a school of their own notwithstanding the efforts of the authorities to restrain them from such extravagance.

Corporal Punishment.—Says Mr. Brereton: "As a believer in the virtues of the cane on rare occasions, I asked a good many teachers their views on the subject. One inspector I spoke to seemed quite shocked at the idea, and must have regarded me, I think, as an inhuman monster. He nevertheless admitted that parents often strike their children. One teacher told me of a case where a parent threatened to prosecute an assistant for accidentally pushing his boy over. The teacher, noticing an open wound on the boy's head, inquired how he had got it, and found it was the result of a blow inflicted by his father, so he set the law in motion against the humanitarian himself.....The situation was very fairly summed up by one who said: 'There is not a good master alive who has not given a "sound smack" to some child in his life.'"

Attendance seems to be worse, on the whole, than with us, the usual hindrances being the experience of the French master as well as of his English colleague.

The Curriculum.—Mr. Brereton deals with the curriculum with fullness and with discretion. In passing, we may mention that, although a second teacher may be claimed for a school of more than fifty scholars, there are still many French rural schoolmasters working single-handed in schools of over fifty; and that the monitorial system, albeit without official recognition, is still in operation in many of the schools: in fact, there is nothing to learn from the French in respect to the staffing of their rural schools.

As fixed by the Decree of July 18, 1887, the curriculum includes moral and civil instruction, reading and writing, the French language, arithmetic and the metric system, history and geography (especially that of France), object lessons and elementary scientific notions, the elements of drawing, of singing, and manual training (principally in application to agriculture), military and gymnastic exercises. This programme is divided into elementary, intermediate, and higher; but the difference is in range and not in subjects, which, with the exception of history and geography, are taught in concentric and not in successive order. With the teaching of these subjects Mr. Brereton was, as a rule, highly pleased. As to the time-tables, although not absolutely fixed, the teacher has nothing approaching the liberty enjoyed by his English colleague, and there is still some truth in the statement that a French Minister of Education may pull out his watch and tell what is being done in schools throughout France.

Agriculture.—All rural teachers are supposed to teach the application of physics and chemistry to the culture of the land. Well, they do: some from books, by way of the memory; some by cultivating seeds in pots with and without manure—the latter sometimes being so unreasonable as to produce the more robust plant, necessitating the teacher, says Mr. Brereton, to change the label, in order to correct the inconsistency of nature. Some have school gardens, whilst experimental fields are in many cases made use of.

A Solution.—And here we read of what seems to us a solution of the agricultural school question as well for England as for France. In one place a piece of ground was secured, and a farmer made the experiments, which were watched by the children under the guidance of the teacher. We commend this idea to Sir John Gorst.

Manual Training is not common, although it is taken in a few villages. One instance is amusing. Some *travaux manuels* in carpentry were given out to the children of a certain commune to finish at home. The school authorities were delighted with the progress of the children, until they discovered the village carpenter was making a handsome thing out of doing the children's work for them!

La Mort aux Maitres.—Mr. Brereton makes much of the *Certificat d'études*, or Leaving Certificate, which children from ten to thirteen make efforts to gain. He would fain see something of the sort in England, as the successor of the old examination system. He gives the pros and the cons, but still decides in favour of the certificate. We have not been able to arrive at the same conclusion. The stupid vanity of the parents, the overwork of the teacher, which one characterised as *mort aux maitres*, and the cramming that is inseparable, as well as the scampering of the children from school with their precious bit of cardboard, are cons which weigh down heavily the advantage supposed to accrue

to the state from this supposed check upon the master's work. Mr. Brereton is right in opining that English teachers would be against him, and so would public opinion, if we are any judges thereof.

Conclusion.—And now we must stop, although we have said nothing of the religious schools, training colleges, evening continuation schools, and other important matters, to say nothing of the omission of Mr. Medd's admirable summaries. But we are consoled by the thought that all practical teachers of enterprise will get the book for themselves, for it is pregnant with thought and brimful of suggestion, and the praise, as we said at the outset, is not small.

A TRAGEDY OF EDUCATION.

THE practical teacher as literary artist is still a sufficiently rare phenomenon to justify some notice being taken of *The Skipper of Barncraig*, the latest work of the writer known by the pen-name of Gabriel Setoun. This author, from the nature of his daily work, is free from the temptation to overproduction, to which most of our modern writers fall so easy a prey. His mode of procedure seems to be that, when he has written one book, he does not begin another until he has something new to say. This is, of course, utterly at variance with much modern practice, when so many believe that the better plan is to go on writing, either using the same ideas over again, or no ideas at all, according as the muse of the typewriter may order it; the world must not be kept waiting. A society is needed to provide for such authors sufficient hard work to remove the temptation to writing, which is the special form of "mischief" for "idle hands to do" that is at present in season. The post of first assistant in a large Board school has provided Gabriel Setoun with the requisite amount of hard work, and a little more.

The Skipper of Barncraig, as the name indicates, takes us back to that old-world village on the coast of Fife which in his earliest writings our author annexed as his own. We are among scenes and types of character already familiar, and, it may be, beloved by us. But the author is not now giving us a series of sketches from nature, or of studies from life. In the earlier works he gave us materials—portraits, incidents, and foreground studies—without combining these into one composition. He has now given a finished picture, and challenges criticism of his conception of the whole, as well as the execution of the parts. This is not, of course, his first novel—*Robert Urquhart* and *George Malcolm* are known to many readers of this journal—yet in this book one is thrown back by the setting of the story so directly on the sketches of *Barncraig* and *Sunshine and Hoar*, that the two former do not seem in the direct line of succession.

The first point that one notes in the *Skipper* is that the responsibility of managing the plot, or development of the whole, has not in the least diminished the brightness and crispness of touch in the more subsidiary portions. The writer has not been overweighted by his conception.

And now for the conception itself. It is one which must often have occurred to teachers, and to all who have to do with guiding the young. Given a boy with a strong natural bent, amounting to genius it may be, in a certain definite direction, and given also family surroundings and traditions entirely at variance with this, and tending with the strength of fate in another definite direction, what can be done to harmonise the discordant elements? and if they are not harmonised, what is likely to be the result?

Laurence Russell (the son, grandson, and great-grandson of sailors, who had looked on it as at once their fate and their pride to live and die as skippers), by one of those freaks which nature delights in, was born with the genius of a musician, and with a physical and mental horror of the family calling. "God help him; he'll never be a sailor," was the verdict of the artist-friend who first realised the boy's genius and revealed it to himself. The father's point of view is given in his remark, "Laurence, my son,.....it'll be a hard life for you, I know; but better get over it when young,—for life has something hard for us all. We'll make a man of you, Laurence." The boy clearly realises the toils into which he has fallen. "I'm to be a carpenter..... That was settled—for me. When my time's out I'm going to be a sailor—and—some day I'll be a skipper, wi' a ship o' my ain—and—some day—I'll be drowned. Oh, it's all settled. Don't bother about it, Phloss."

A few years later, he is able to see still more clearly the nature of the problem before him. "Is the making or the shaping of my life mine?.....My great, great—I don't know how many times great—grandfather has more to do with it than I have. I was flung into life with the storm that flung mother out of it, wasn't I? I was flung into carpentering as I was flung into the sea yesterday; and I'll be flung out of life, when my time comes, with as little consideration. What have I got to do with this life? It's me, but it isn't mine.....I've less to do with it than you, in fact; for you would have me a carpenter, and you managed it. It's funny. I wonder if I'll have the making of somebody else's life in my hands. I suppose I must have, in this fine scheme; I ought to have, when others have the making of mine. And most likely I'll make as great a mess of it. That should balance matters. What was it the Greeks called it? Nemesis? Nemesis coming like a policeman and taking up the wrong man."

The problem as stated here, and as present to the writer's mind, is more than the mere problem of education and choice of profession; it is the deeper problem of Fate—the individual whose environment and hereditary or natural endowment are at war. But for practical purposes one may consider it in the form first suggested, as what the transatlantic educationist would call a problem in the Pedagogy of Adolescence. For, after all, environment, when used of human life, has a different meaning from that which it carries in the biological sphere. The environment of a child is not a fixed quantity. His own nature and choice determine in part, and the wisdom and care of those about him in greater part, the kind and degree of influence which his environment shall exert, or the elements in his total environment which shall have the efficiency of the total surroundings in the biological sphere. And this selection of influences from the total possible is just what we mean by education.

In this aspect our readers will find *The Skipper of Barncraig* well worth study. But the book is by no means a discussion of this problem. The work of the artist is not to discuss or to be didactic; it is merely to represent and interpret by means of the concrete example. The book is an instance of the problem, not a discussion or a solution of it. And even briefly as we have presented the case, it is clear that only one result could follow—tragedy. How that tragedy comes about it would not be quite fair for us to indicate, even if space permitted.

The development of the brief wasted life of the hero, of whom we may say, "From the great deep to the great deep he goes," is wrought out with much artistic skill. The lines are firm and strong, but never harsh. The subsidiary characters and incidents are also charmingly depicted, and show all the keenness and all the geniality of the author's earlier sketches.

The profound human interest and the tragic pathos of the tale are apt to make one forget that the work has other qualities. As an interpretation of humble village life it is admirable; and the gatherings of the village worthies at their favourite haunts, with their crisp and striking comments on persons and things, represent great power in the writer. In his dealings with nature, he shows the wonderful influence which the sea acquires over the mind of those who live on it or near it. One is impressed with the idea that Gabriel Setoun is himself Laurence Russell, in respect of the glamour and mystic meaning which the sea reveals; though, in the case of the hero, it is joined with a deep-seated terror and aversion. No one who had not spent his youth within the sound of the sea could have created a hero with this special susceptibility so finely and consistently represented, and it may be that only those who understand the language of the sea will be able fully to appreciate how fine and how rare is the author's accomplishment in this matter.

The work is one to read and enjoy, and afterwards to ponder deeply in its ultimate bearings on life. That the author is a member of our not overpraised profession is a legitimate cause of pride for every practical teacher.

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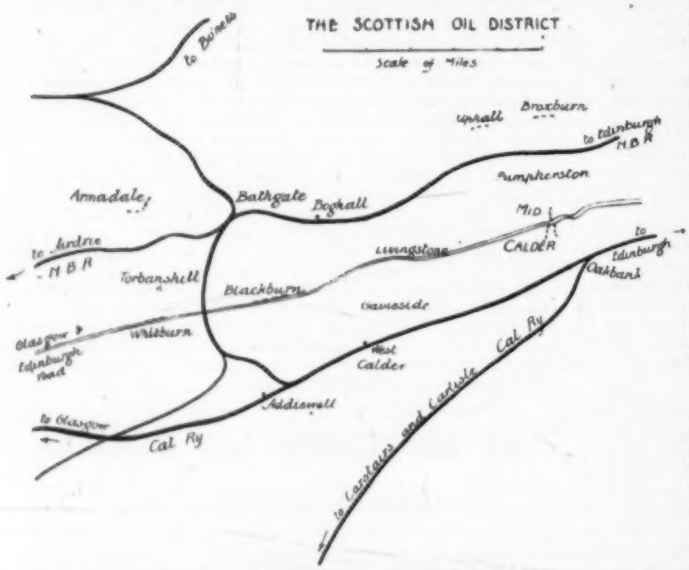
PARAFFIN.

I.

THE name paraffin bears a variety of meanings. To most people it signifies paraffin oil, to others that white solid known as paraffin wax, while to a chemist paraffin is the name of a very large class of hydrocarbons, all having the general chemical formula C_nH_{2n+2}. The first of this series is a light gas, methane, CH_4, known also as light carburetted hydrogen, marsh-gas, or fire-damp. The second is a heavier gas, ethane, C_2H_6; the third a still heavier gas; and so on till the fifth is reached in pentane, C_5H_{12}, a liquid which boils at a little above blood heat. Then follow liquid paraffins of increasing density and rising boiling points, and it is these which form the bulk of petroleum, paraffin oil, kerosene, and other liquid forms. Finally, when the sixteenth member of the series is reached, $C_{16}H_{34}$, the substance



proves to be a soft, buttery solid, melting at only 21° C.; and it is succeeded by more solids with a higher density and higher boiling point, running up to $C_{20}H_{42}$, one of the leading substances in paraffin wax. It thus appears that the chemical term includes both paraffin oil and paraffin wax.

Paraffin is got from two sources—oil shale and petroleum, mineral oil or rock oil. The former is seen to perfection in the Scottish oil shales, which are found in that triangular patch where the shires of Lanark, Linlithgow, and Edinburgh meet, and which have formed the oil towns of Broxburn, Bathgate, Mid Calder, and West Calder. The subjoined description of the extraction of paraffin oil from shale applies to the Broxburn works, but the process is practically the same everywhere.

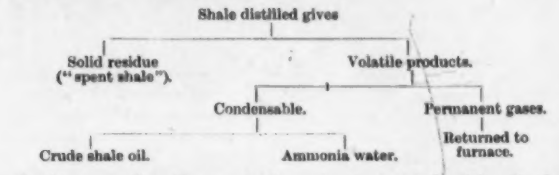
Petroleum occurs in the Caspian region of Russia, round the town of Baku, and also in the United States, especially in Pennsylvania. Smaller deposits are also found in Canada, India, and Galicia. In all these places the oil occurs in underground reservoirs, which are tapped like wells. In many cases the oil not only rises to the surface, as water does in a common artesian well, but it is ejected from the shaft with considerable violence, forming an oil-spout. This result is due to the presence of gaseous paraffins, which increase the pressure on the liquid oil, and force it up more rapidly than ordinary air-pressure can do. Many of these mines have contrivances for "winning" this natural oil-gas, so as to use it for heating and lighting.

Lastly, we may include in this list two substances which, though not true paraffins, are closely allied to them—ozokerite, a black mineral found in Galicia, often used in candlemaking; and also the various kinds of asphaltum, of which the natural pitch of the Trinidad lake may be taken as an example.

The processes for obtaining paraffin from these sources are all very much alike, and the following description, which applies to Scotch shale, practically includes all the principles and most of the methods employed. Oil shale is a black mineral, not unlike cannel coal, but, as its name implies, more foliated, splitting into thin even plates, like slate. It occurs in seams, and is mined like coal. On reaching the surface it is taken to the breaking machine, and is broken up into small pieces about three inches square or so, and these are conveyed to the retorts in loads of about 12 cwt. at a time.

The first chemical process is that of distillation, which resembles the distillation of coal in gasworks. The retorts used for shale are vertical, 28 feet long, the upper 11 feet or so being iron, and the lower portion fire-brick. They are set in groups of four, and are worked continuously, fresh or "green" shale being introduced by a hopper at the top, while the spent shale is withdrawn at the bottom. The distillation really takes place in the upper or iron portion of the retort, and from this mains carry off the volatile products, to be condensed as far as possible, forming crude oil and ammonia water; while the permanent or incondensable gases, resembling coal-gas, are returned to the furnace to be used as fuel, or are burned around the iron portion of the retort, thus giving an outside top heat. To aid in the production of ammonia, steam at high pressure is introduced into the upper portion of the retort, and the temperature here is kept much lower than in gasmaking—about 900° F. The spent shale then descends to the brick portion, where the temperature is as high as 1300° F., and here there is a greater production of

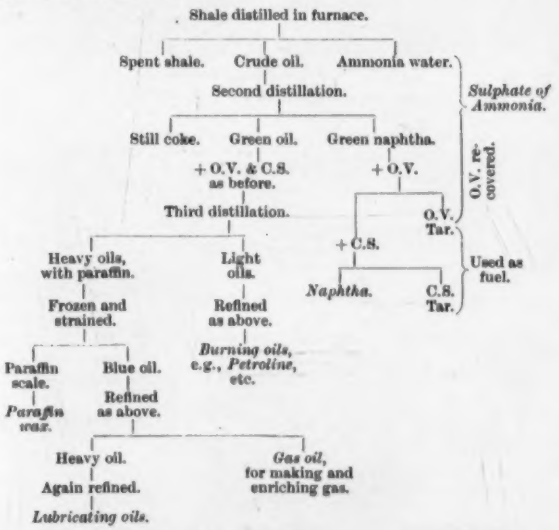
ammonia and other gases. The carbon also of the shale is all burned off, leaving nothing but clayey matter, which is discharged from the bottom of the retorts as "spent shale," and piled up in bings as being of no further use. These products of distillation may be tabulated thus:—



As in gasworks, the ammonia water is treated with oil of vitriol (sulphuric acid), the result being a valuable manure, sulphate of ammonia. The crude oil now undergoes "fractional distillation"—a term which requires a little explanation.

Every pure liquid has a definite boiling point in an open vessel: water boils at 100° C., alcohol or spirits of wine boils at 78° C. If, however, a mixture be made of water and alcohol, it is possible to separate these two very completely by boiling the mixture at regulated temperatures. Take two similar flasks, A and B—A for an evaporating flask or still, and B for a condenser. Flask A contains some beer, which has from five to eight per cent. of alcohol; and it is fitted with a two-holed indiarubber stopper, carrying a thermometer whose bulb dips into the liquid, and a leading tube passing down to the bottom of B. The second flask may be put in a basin of water and surrounded by a wet cloth, or it may be cooled in any other way. On heating the liquid in A, the mingled vapours of water and alcohol pass over into B, for water-vapour is given off even from a lump of ice. By watching the thermometer and keeping the temperature, say, at 79° or 80° C., a little above the boiling point of alcohol, the whole of this substance will be driven off, so that B now contains all the alcohol, *plus* a slight amount of water-vapour. On treating the contents of B in the same way, the water-vapour is still further reduced, and the alcohol obtained fairly pure.

This is the whole process of oil distilling, with the addition of removal of tarry matters. When oil of vitriol (sulphuric acid) is added to these shale oils, a black tar falls to the bottom. This is run off, under the name of acid or vitriol tar. The sulphuric acid is recovered from this and used for making sulphate of ammonia, as already mentioned, while the tar is often burned in the furnaces, being introduced as a fine spray under high-pressure steam. When the oil of vitriol tar has been removed, caustic soda is now added to the oil, bringing down "soda tar," from which the soda is also recovered for further use. Thus refined, the oils are ready for a second distillation, and so on. The whole process is shown in the following table, in which O.V. and C.S. mean respectively oil of vitriol and caustic soda, and the finished products are in italics:—



The still coke which is left from the second distillation is a valuable smokeless fuel. Several qualities of naphtha may be produced, of different specific gravities, ranging from ·725 to ·740.

The burning oils which result from the third distillation are also of different specific gravities and "flash-points"—a term to be explained later. Some of these made by the Broxburn Company are—

	Specific Gravity.	Flash Point.
Petroline	·800	110° to 120° F.
No. 1 paraffin oil	·806	120° F.
Lighthouse oil	·810	160° F.
Marine sperm	·830	230° F.
Mineral colza	·840	250° F.

The gas oil shown in the table is heavier still (specific gravity, ·840 to ·850), and it "flashes" at 200° F. The lubricating oils are thicker, heavier, and more difficult to burn, having flash-points ranging from 300° to 350° F., and this series includes, in the case of American and Russian petroleum, the well-known substance *vaseline*, which is intermediate in character to those thick oils and the softer forms of paraffin wax. Several varieties of solid paraffin are also obtained, among which may be mentioned "match paraffin," a soft paraffin melting at 100° F., and extensively used for soaking the ends of wooden matches.

Roughly speaking, 100 tons of shale yield these products as under:—

Naphtha	5
Illuminating oils	37
Lubricating oils	17
Paraffin wax	13
Loss (spent shale, etc.)	28
	100

Another way of putting it is to say that a ton of Broxburn shale yields 32 gallons of crude oil, and about 46 lbs. of sulphate of ammonia; while the lower shales yield 20 gallons of oil, and over 72 lbs. of sulphate.

The fractional distillation of American or Russian petroleum is carried on in the same way, but the names differ. The distillate corresponding to our "green naphtha" is benzine (not benzene), and yields petroleum spirit, a valuable solvent of fats and indiarubber. Kerosene is the name given to refined paraffin oil, corresponding to petroline, etc.; while vaseline is obtained from the thicker lubricating oils after separation of their paraffin wax. These lubricating oils are known as spindle oil, machinery oil, and cylinder oil, the last being the heaviest. There is an artificial vaseline made in Germany by dissolving paraffin wax in some of these heavy oils, thus reversing the above process.

Ozokerite is a black mineral like dull coal. It is mined in Galicia, and yields a wax which is largely used in candlemaking.

Asphaltum, as found in the pitch lake of Trinidad, is really a very condensed petroleum, and may be of all consistencies from a thick treacly liquid to hard rock. When purified from water on the one hand, and earthy matter on the other, it is ready for use in paving. For this purpose it is heated with heavy paraffin oil, so as to form "asphalt cement," and this is mixed with sand and other mineral matters in street boilers and applied hot. Val de Travers paving is similar to Trinidad pitch, but it is generally mixed with some of this before use. Ordinary asphalt paving is simply a mixture of sand, etc., in common pitch obtained from coal-tar. The process of mixing and applying this material is too common to need description.

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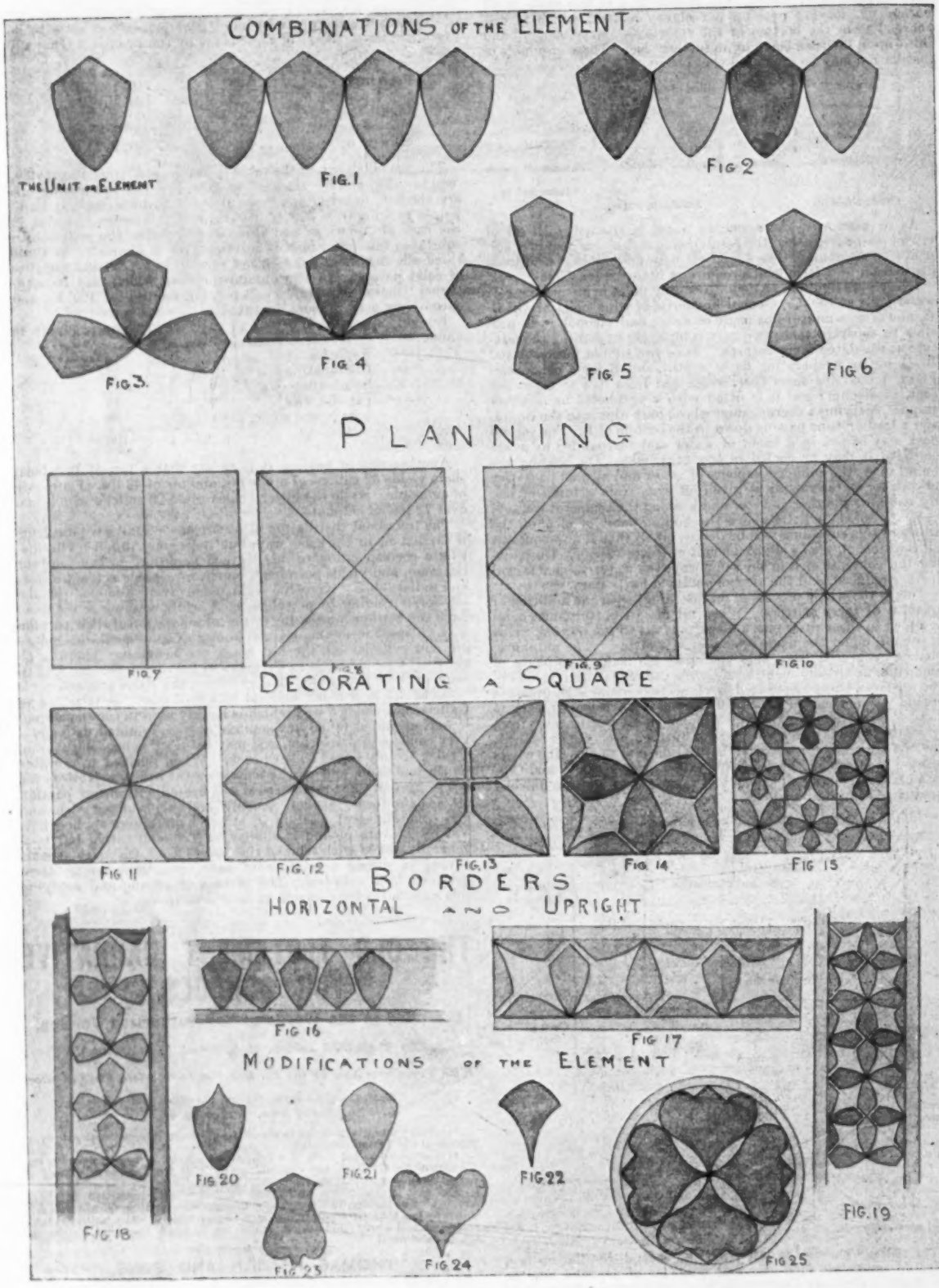
COMBINATIONS OF THE ELEMENT
THE UNIT OR ELEMENT
FIG. 1
FIG. 2
FIG. 3.
FIG. 4
FIG. 5
FIG. 6
PLANNING
FIG. 7
FIG. 8
FIG. 9
FIG. 10
DECORATING A SQUARE
FIG. 11
FIG. 12
FIG. 13
FIG. 14
FIG. 15
BORDERS
HORIZONTAL AND UPRIGHT
FIG. 16
FIG. 17
MODIFICATIONS OF THE ELEMENT
FIG. 18
FIG. 20
FIG. 21
FIG. 22
FIG. 19
FIG. 23
FIG. 24
FIG. 25

HOW TO COMPILE NOTES OF LESSONS.

BY T. HUDSON, HEAD-MASTER OF KEPLER BOARD SCHOOL, LEEDS.

VI.—DRAWING LESSON (DESIGN).

THE time to be devoted to the following lesson has been omitted. It is not intended that the whole of the matter should be gone through in one lesson; but it was thought advisable to arrange in one connected whole as much matter as is sufficient in itself and what it suggests to form the basis of two or three lessons. It will be sufficient for one lesson to take the first three heads and apply them to the decoration of a square only. The decoration of rectangles, triangles, borders, and circles should be left for future lessons.

The element chosen should be one which is easy to draw, that a pattern may be quickly made. The one selected in this case is from Petty's *Elementary Lessons in Design*, Book III., p. 15. The scholars will find a wide and interesting field for exercising their ingenuity in decorating spaces, with the element slightly modified. One or two suggestive drawings are given in Figs. 20 to 25.

When simple elements are used, it will be advisable to have several of the units on a large scale, cut out of white and brown paper. Some of them should be cut into two equal parts. These should be arranged by the scholars, in front of the class, in pleasing combinations. They should also be arranged within suitable chalked spaces. When bad arrangements are made, the teacher should point out why such arrangements are not good. Facility in arranging concrete units in the lower standards will give increased dexterity and intelligence in pattern-making and design in the higher standards.

NOTES OF A DRAWING LESSON (DESIGN).

Class.—Standard IV. Time.—See preliminary remarks. Element.—See opposite page.

Heads.	Matter and Plan.
The Element.	1. The simplest form which we use in decorating spaces is called the *unit* or *element*. 2. By *repetition* this element may form a design. 3. The simplest form of repetition or combination is by placing the elements side by side, as in Fig. 1. 4. Variety may be given to this design— (*a*) By colouring differently the alternate elements (Fig. 2). (*b*) By inverting the alternate elements (Fig. 16). (*c*) By letting them overlap, etc. 5. They may be combined to make a plant-like form (Figs. 3 and 4). Note that in Fig. 4 one element and two halves are used. 6. If a fourth member be added to the combination in Fig. 3, we get a cross-shaped form, as in Fig. 5. To illustrate the above, several large elements will be placed before the class, cut out of differently-coloured paper (white and brown). One or two of the elements will be cut into two equal parts, and the class will be asked to make suitable combinations.
Planning the Space.	1. If a large space has to be decorated, it must be split up into smaller portions of a suitable shape. 2. Figs. 3 and 4 would easily fit into a triangle, and Fig. 5 into a square. 3. By slightly altering the shape of the combination in Fig. 5, it could be made to fit into a rhombus. 4. Hence, in this case, a large space may be split up into triangles, squares, rhomboidal shapes, or combinations of these (Figs. 7, 8, 9, and 10).
Arranging the Element.	1. The element may be arranged in various ways in the spaces—for example, in a square. (*a*) It may radiate from the centre diagonally (Fig. 11). (*b*) Or vertically and horizontally (Fig. 12). (*c*) The element may spring from the angles and meet, or nearly meet, in the centre (Fig. 13). (If the elements are modified as in Fig. 20, they could be made to meet in the centre.) 2. Similarly, in other spaces the arrangement may be modified. 3. Choose the arrangement that best suits the figure to be ornamented, and leaves no large spaces undecorated.
To decorate various Figures.	1. *The Square.* (*a*) If not very large, the diagonals only need be drawn, and the element used to fill the space without further subdivision (Fig. 11). (*b*) A diamond square may be drawn by joining the middle points of adjacent sides, and the element arranged as in Fig. 12. This leaves four triangular portions, which may be decorated as in Fig. 14. (*c*) The diagonals may be drawn, and the element may spring from the angles, as in Fig. 13. (*d*) The square may be divided into four triangles by drawing the diagonals, and each of these may be decorated like the triangles in Fig. 17. (*e*) A large square may be divided into four small squares, and each may be decorated as in Figs. 11, 12, 13, 14. (*f*) Or it may be divided and decorated as in Fig. 15. 2. *The Rectangle.* This may be treated like the square. 3. *Borders.* May be made— (*a*) By placing the elements side by side, as in Figs. 1 and 2. (*b*) By reversing alternate elements (Fig. 16). The alternate elements in both cases may be differently coloured. (*c*) By dividing the space into triangles, and decorating each, as in Fig. 17. Note that one combination is upright and another pendent alternately. These may be differently coloured. (*d*) A border may be made by arranging as in the upper third of Fig. 15. (*e*) Figs. 18 and 19 are examples of upright borders.
Modification of the Element.	1. The element may be modified to suit the space it is desired to fill. 2. It may be shortened and broadened, or lengthened and narrowed, as in Fig. 6. 3. The straight lines at the top may be curved outwards or inwards (Figs. 20 and 21). 4. The side curves may have their concave sides turned outwards (Fig. 22). 5. The shape may be further modified as in Figs. 23 and 24. Fig. 25 shows the element modified to suitably fill a circle.

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SUGAR.

Cane v. Beet: Bounties.

HOW very largely sugar ministers to our necessities is borne out by the prominent position the commodity occupies among our imported food-stuffs, for in point of value it is only exceeded by grain, cotton, wool, and meat.

Though its original habitat may be uncertain, there seems no reason to doubt that the sugar-cane was first cultivated in the region extending from Bengal to Cochin China.

The Spaniards planted sugar-canes in Madeira, from whence they carried the cultivation to the New World. In the Middle Ages, Venice became the chief European sugar-mart, and it was a Venetian who first succeeded in producing loaf sugar. In 1319 we find a record of 100,000 lbs. of sugar entering the port of London in exchange for wool; at which time the price was somewhat near two shillings per pound. The increasing use of tea and coffee made sugar more of a necessity than a luxury, and in the eighteenth century it took its place among the more important of our food commodities. The steady growth of our sugar imports will be seen from the following returns:—

Year.	Tons.
1700	10,000
1800	150,000
1885	1,100,000
1895	1,552,000
1900	1,626,000
1901	1,750,000

Many vegetables and plants yield sugar in small quantities, but the chief sources of the sugar of commerce are the sugar-cane and the beetroot.

Cane sugar is the product of a saccharine grass, a stout perennial growing from six to twenty feet high. The chief cane regions lie in two different parts of the globe, roughly divisible into the West and East Indies and adjacent countries. The manufacture of sugar is comparatively simple. The juice is expressed from the canes as they pass between heavy rollers, or it is obtained by diffusion, in which process the canes are cut into short lengths, and the juice obtained by treating with hot water. The juice is then subjected to boiling, during which various impurities are removed. When it has reached a certain point of concentration it is placed in perforated hogsheads, from which the molasses drains off, leaving raw sugar or *muscovado*. The raw sugar undergoes various further processes of filtration, boiling down under pressure and clarification, resulting in various degrees of purification and crystallisation.

Beet Sugar.—The Napoleonic wars greatly interfered with the entry of cane sugar into Europe, and caused a considerable increase in the price of the commodity, and attention was called to the presence of sugar in various fleshy roots common to temperate regions, of which the beetroot was the best example. The process of manufacturing sugar from beet differs but little from that of treating sugar-cane. The first beet-sugar factory was established in Silesia in 1801. By 1830 the industry was firmly established in France, since when it has advanced with gigantic strides, until now more than half the sugar of the whole world is made from beet cultivated in Germany, France, Austria, Holland, Belgium, and Russia.

Beet v. Cane.—Before the introduction of beet sugar the cultivation of the sugar-cane was extremely profitable; but it was carried on under tropical skies, chiefly by means of slave labour. The abolition of slavery in 1833 seriously retarded the cane-sugar industry in the British West Indies, just at the time when beet sugar was commencing to be a serious rival. European nations, too, brought various scientific processes to bear on the manufacture, with which the more crude methods of the cane planters could compete only at a disadvantage.

The beet-sugar trade, however, would not have reached such remarkable dimensions had not the beet-producing countries adopted a system of protection, and the establishment of bounties paid to the beet farmers on the roots produced, or to the manufacturers on the quantity of sugar exported.

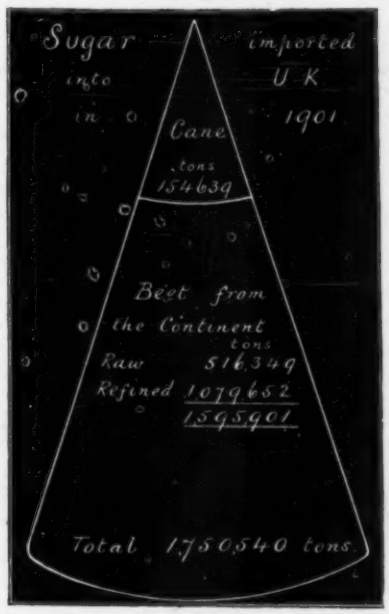
The following figures show the remarkable increase in the world's sugar-crop, and still more markedly the advance of beet:—

	1881. Tons.	1885. Tons.	1900. Tons.
Beet sugar.....	1,774,000	2,546,000	5,607,000
Cane sugar.....	1,979,000	2,260,000	2,839,000
	3,773,000	4,806.000	8,446,000

The United Kingdom is the only open sugar market in the world, and bounty-fed beet sugar has almost driven the cane-product from our shores. Our diagram shows to what extent the latter has suffered in the competition. In the year 1900 we received from—

	Tons.
Germany.....	756,000
France.....	454,000
Holland.....	140,000
Belgium.....	133,000
British West Indies.....	42,000

During recent years it has been stated that the countries that pay the bounty reap so little benefit from it that



the general abandonment of the system may be looked for, perhaps almost in the immediate future. Last year the cost to France, Germany, and Austria was £4,444,000, £1,400,000, and £720,000 respectively. At the moment of writing, a conference is sitting in Brussels discussing the question. England, the chief consumer of foreign sugar, is in a position to dictate terms, but prefers the voluntary relinquishment of the bounty; in the alternative she must penalise those countries which send her sugar but retain the bounty. Last year a tax of one halfpenny per pound was imposed on imported sugar, and it is felt that this should be raised on all except the colonial product. The colonial cane sugar, superior to that of beet, would then be able to successfully compete in the home market, with the result that the consumer would be able to get a better article with little or no appreciable increase in price. This, however, would not be all the benefit we should receive. British shipping would gain correspondingly, sugar refineries now closed in the British Isles would be reopened, and the West Indies would regain their former prosperity.

In some quarters it is claimed that the bounties are in

the nature of a present to England, and that it would not pay us to refuse a present of some five or six millions sterling to make a market for colonial sugar. But is it a present? What does the foreigner receive in return? He monopolises our supply, and as the price of sugar averages about £15 per ton, the value is roundly 25½ millions per annum—a monopoly well worth struggling for. The foreign beet-grower has become refiner too, with a disastrous result to the British industry. Suppose, for example, the United States, instead of sending us raw cotton, sent the finished article in its place. The ultimate effect upon Lancashire needs no demonstration, and the sugar industry presents an exactly analogous process. The greater part of the 25½ millions might be kept in our own pockets. Twenty shillings per ton extra duty would put colonial sugar on an equality with beet, and this would amount to less than one-eighth of a penny per pound. India, in self-defence, has adopted a countervailing duty, with excellent results.

That the subject is of national importance is shown by the reference in the King's Speech at the opening of Parliament, when he expressed the hope that the decision of the International Conference would lead "to the abandonment of a system by which the sugar-producing colonies and the home manufacturers of sugar have been unfairly weighted in the prosecution of this most important industry."

Beet Cultivation in England.—The abolition of the bounty system would allow British agriculturists to compete successfully with other European nations as growers of beet sugar. During the last dozen years experiments have been conducted that almost conclusively prove this. In 1898 forty-seven experiments were made: the quantity of sugar obtained in 100 parts was 15·65, and the quotient of purity 85·19. In Germany, during the same period, the quantity of sugar was 16·75, and the purity 84·17. The next year the British figures were 17·18 and 88·04, against 17·38 and 86·9 for Germany. These figures speak for themselves, and it must be borne in mind that in Germany the cultivation of beet has reached a stage of the highest scientific success. The British farmer may yet have a profitable field of enterprise opened up to him if he will only seize the opportunity when it offers, and the time may come when British home-grown sugar shall find a place on the breakfast-table of the nation.

THE INSPECTOR'S QUERY COLUMN.

BY AN INSPECTOR OF SCHOOLS.

Letters intended for this column should be addressed "Inspector," care of Editor, PRACTICAL TEACHER. Only in very urgent cases can replies be sent by post, and then only when two stamps accompany the letter.

Readers are invited to seek advice upon any question coming within the purview of schoolcraft.

Senior Certificate, Welsh Board. *J.J.* asks, "Does the Senior Certificate Examination of the Central Welsh Board qualify me to be an assistant teacher without passing the Matriculation Examination?"

Answer.—Under the Code of 1901, the Senior Certificate qualifies you, provided you passed in (1) Elementary Mathematics, (2) in English Literature or History.

If you passed this examination before 1st September 1901, it does not matter whether you took Mathematics and Literature or History.

The Matriculation Examination qualifies as well as the examination you refer to, and not in addition to it.

If you are seeking entrance to a college by means of this certificate, then it is necessary to obtain it "in such and so many subjects in combination as are recognised by the University of Wales as equivalent to the Matriculation Examination of the university."

The Law *re* Expulsion of Scholars. *J.W.* puts me an awkward but interesting question in school law. A parent claims exemption from corporal punishment for her child. The authorities grant the same, but state that in case of any breach of discipline the child will be expelled. I am asked: "Has the Board the power to turn a child out of school for any breach of discipline? If not, what steps should be taken to put matters right?"

My opinion is that the authority has not the power, except in very exceptional cases, to expel scholars for breaches of discipline. "If a child is guilty of *gross insubordination*, and the punishments prepared by the rules of the school all fail to remedy the evil, the Board of Education hold that this is a "reasonable ground for exclusion" (Official Letter, April 1885). Writing on 31st August 1898, the Education Department say, "My Lords will require to know fully the circumstances in any particular case before deciding whether they should consider a refusal to admit a child on account of insubordination to be reasonable under Article 78 of the Code (33,028–98)" (N.U.T. Code, 1900, page 191). Article 17 (*a*) of the Scotch Code says no child must be refused admission on other than reasonable grounds. If the parent merely asked for exemption from *corporal* punishment, clearly the authority is acting *ultra vires*. (See Nelson's *Annotated Scotch Code*, Omnibus Chapter.)

I advise your friend to respectfully put it to the managers that he has no objection to other forms of reasonable punishment, and that he thinks they have no right to expel on the ground of breach of discipline unless "gross insubordination" can be proved.

K.S. Exam.: Girls may take Mathematics *vice* French. *J.C.* asks—1. Will my pupil teacher who took first year's papers last October have to take second year's papers next April? 2. Will she be able to sit for Scholarship Examination next December? She will be eighteen years old in November. 3. May she and two others take Mathematics instead of French?

Answer.—1. No. 2. Yes. 3. Yes. The mistake possibly arises from the fact that a separate paper in Mathematics is set for girls, whereas the boys have a paper in Algebra and one in Euclid. The girls have one paper, including Algebra and Euclid, which, according to footnote, page 5 Scholarship Syllabus, "may be taken in lieu of a language."

Passing K.S. does not free from Apprenticeship. *Balurtyme* asks whether the passing of the K.S. Examination frees him from his apprenticeship, and allows him to claim salary as an assistant master.

Answer.—Your apprenticeship dates from 1st January 1899, and if you were bound for four years, your time will not be up until 31st December 1902. You are a pupil teacher until the end of apprenticeship, irrespective of what examinations you may pass.

I advise you to try to persuade the Board to free you from your apprenticeship by cancelling the indentures. That is often done.

"Till" and "until." *Athol A.C.S.* desires information as to the different uses of the words "till" and "until."

Till = preposition, a word of Danish origin. It occurs in the *Durham Gospels* (eleventh century). This word is equivalent in meaning to "until." It is often used before verbs and clauses—for example, I will wait till you arrive. It also has the meaning "as far as"—for example, I have kept silent till now.

Until = compound preposition, unt + till (*Morris*). It is used before nouns of time, and precedes a sentence or clause—for example, until the dawn breaks. Until we have spoken, there is no case to answer. *Until* sometimes = till the time that.

1902 Certificate Examination: Science for Acting Teachers. *W.E.G.* desires information respecting the sciences to be taken by acting teachers in the Certificate Examination.

Answer.—Clearly your last result will not help you. You may not obtain marks for the Elementary Stage in the second year's Certificate Examination, as you have already passed at a Science Examination. "Physiography must be taken by all candidates offering science who have not previously passed either in the Elementary Stage of the subject at a Science Examination, or in the corresponding subject at the King's Scholarship Examination."

Knotty Points in Registration. *Alpha* writes to me respecting my advice on registration given in the February number. I am much obliged to him for the trouble he has taken to show me how he deals with the difficulty in his own school. He says: "In the case of a child marked absent who is really present, the nought is cancelled, and a stroke put above it. In the case of a scholar marked present who is really absent, it is an easy matter to convert the stroke into a nought, and still leave the correction clearly visible. The advantage of this plan is that not only is every correction shown, but it is impossible afterwards to mistake what is meant." I submit for my readers' advantage an illustration given by *Alpha*.

Leaving Certificate. *B.S.B.*—Can you write to me giving particulars as to the syllabus? and I will reply by post. Enclose addressed envelope and two stamps.

A COURSE OF OBJECT LESSONS FOR GIRLS' SCHOOLS.

BY WILLIAM DONE, B.A.,
Head-Master of Brighton Pupil Teachers' School.

XXII. BLEACHING.

Articles of Illustration.—A pennyworth of chloride of lime; pieces of bleached and unbleached calico, coloured silk, and wool; a few violets; gas jar or glass jam-pot; very small piece of sulphur; a little sulphuric acid; basins of water.

Experiment and Observation.	Result or Inference.
1. Contrast a piece of calico which has been in use a good time with a piece of new unbleached calico. State that the first piece of calico was just like the second piece when it was bought.	The constant washing and the drying in the open air have had the effect of whitening the calico; but though now white, it is considerably thinner, and not so strong as when it was new.
2. Show pieces of silk ribbon, new and faded. Refer to the fading in the colour of clothes, etc.	The open air has a great effect in causing colours to fade.
3. Refer to previous lesson on Air, and to the active principles of oxygen.	No doubt it is the oxygen of the air which oxidises the colouring matters and forms colourless compounds, just as it oxidises iron, for example, and forms red iron rust.
4. Contrast two separate portions of a piece of coloured silk or other suitable material, one portion having previously been boiled with washing soda.	Boiling with soda, or even washing with soap which contains an excess of alkali, will discharge the colour much faster than the action of the air does.
5. Show some chloride of lime, pass it round the class. Let the girls note its colour and smell. Ask what use is made of it at home.	Chloride of lime is a strong disinfectant, used for drains, but not for disinfecting clothes. It has a strong smell peculiar to itself.
6. Constituents of chloride of lime ascertained.	As its name implies, one of its constituents must be lime. [The teacher might show how it is made—namely, by passing chlorine gas into freshly-slaked lime.]
7. Put a little of the chloride of lime into a basin of water. In another basin of water pour a little sulphuric acid. Rinse some article required to be bleached alternately in each basin until the colour is destroyed.	This is a very quick method of bleaching articles, and is preferable to continual washing and drying in the open air, because in the latter case the material would be fairly worn out before it was bleached.
8. Repeat the experiment with other coloured textile materials.	It is plainly seen why chloride of lime is sometimes called bleaching-powder.
9. Burn a very small piece of sulphur in an iron spoon or on a metal disc. Hold a few violets above the fumes.	The violets quickly lose their purple colour and become quite white. We suspect that sulphur fumes act as a bleaching agent.
10. Place the bleached violets in a glass in which is some dilute sulphuric acid. Note result a little later on, as a few minutes are required for the reaction to take place. At this point the result on some flowers previously experimented upon might be shown.	The oil of vitriol solution has acted in quite the opposite way to what it acted with the bleaching-powder. It has actually brought back a good deal of the colour.

Additional Information.—An outline of the whole process of bleaching might be given, as regards vegetable fabrics like cotton and linen.

The substance must first be cleansed from grease and other impurities by being boiled with soap, soda, or slaked lime. It is then steeped in bleaching-powder and water, and again in a weak solution of sulphuric acid. Finally, it must be well washed, to remove all traces of the acid, which would otherwise quickly rot the material.

Calico, when thus bleached, is frequently "dressed" to give it an appearance of substance and quality.

The dressing could easily be shown in a new piece of cheap calico. If such material be torn quickly or even rubbed briskly, the stiffening substance, which is usually some preparation of starch, falls out as a white powder.

Woollen, silk, and straw goods are not bleached by means of chloride of lime, because these substances would be injured by the action of the chlorine; therefore sulphur fumes are employed.

XXIII. DYEING.

Articles of Illustration.—Small pieces of white silk, white flannel, bleached calico; a little cochineal, red ink, black ink; a cake of washing blue, and a small bottle of some aniline dye; pieces of fast-dyed substances, as red flannel, blue cloth, etc.; basins of water, glasses, cups.

Experiment and Observation.	Result or Inference.
1. Pour into three separate cups red ink, black ink, solution of cochineal. Soak pieces of flannel in each.	The flannel takes in each case the colour of the liquid in which it is dipped.
2. Show similar pieces of the same material dipped in the same liquids previous to the lesson and dried. Let three girls wash these pieces separately in basins of water.	The colouring material at once washes out.
3. Let another group of girls wash the specimens of fast-dyed materials.	The colours are fast; they will stand washing.
4. Let girls again dip pieces of white silk or flannel into indigo solution (blue-bag) and into some aniline dye. Let girls also wash pieces previously dipped and dried.	Substances dipped into indigo solution or into aniline dyes keep their colours. [Some of the colour may wash out, but not much.]

Additional Information.—Dye materials fall into two classes—those capable of giving a permanent colour to materials which are dipped into a solution of them, and those which dissolve out again into the water when the material which has been stained is washed. Aniline dyes and indigo belong to the first class, while the majority of vegetable dyes—cochineal, madder, logwood, etc.—belong to the second class.

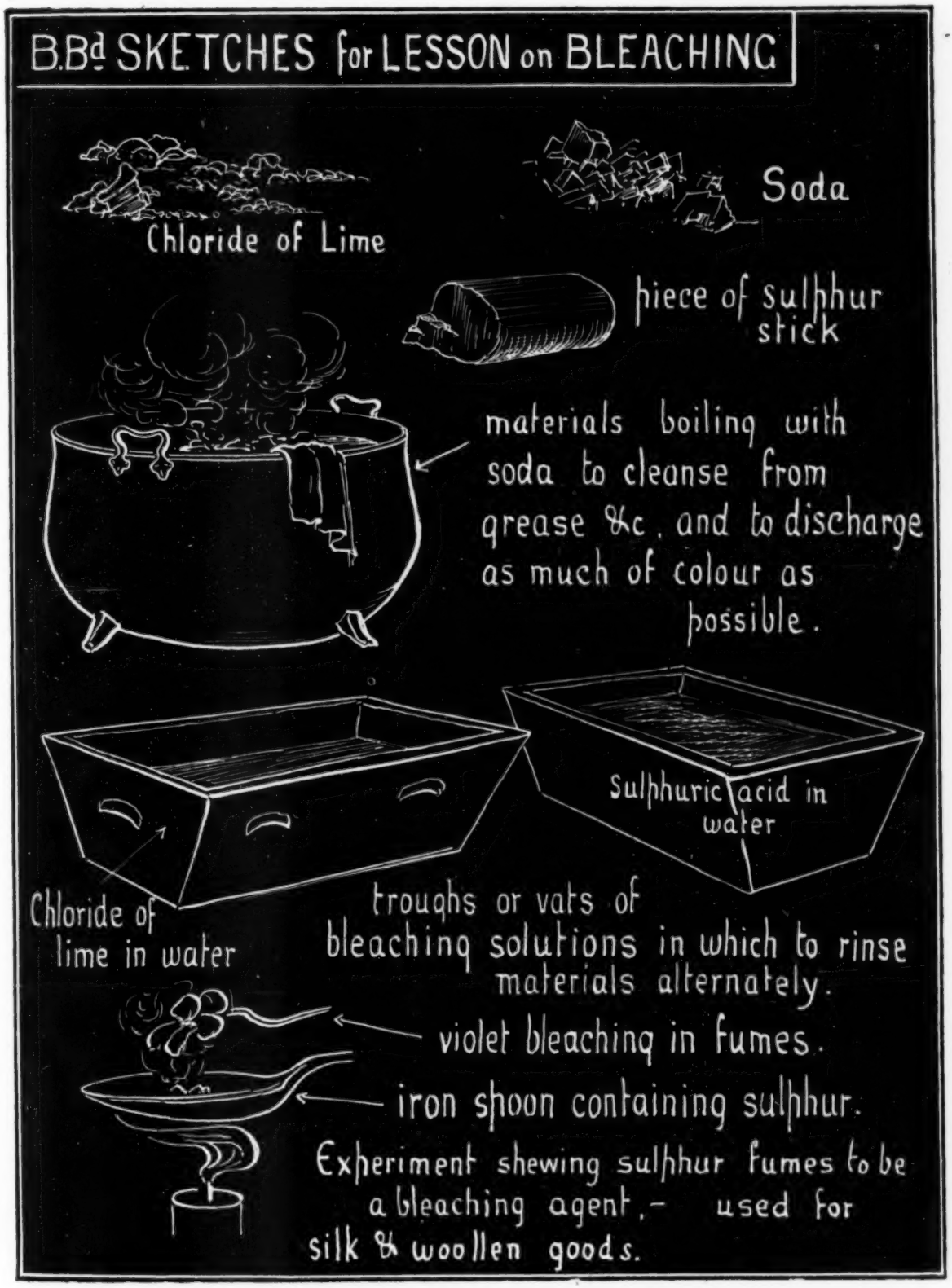
To prevent these vegetable dyes from washing out, the materials are dipped into a fixing solution called a mordant (French *mordre*, to bite or corrode). Mordants are such things as common alum, salts of tin, iron, etc. Sometimes the mordant and dye are mixed together.

As its name implies, the mordant has a strong tendency to fix itself into the fibres of the material, and in doing so it combines with and fixes the dye.

All cotton and linen goods must be bleached before dyeing; silk and wool must be thoroughly cleansed.

BLACKBOARD ILLUSTRATION.

BY C. ARMSTRONG, ART MASTER AND SOUTH KENSINGTON EXAMINER; PRINCIPAL OF ARMSTRONG'S DRAWING SCHOOL.


B.Bd SKETCHES for LESSON on BLEACHING
Chloride of Lime
Soda
piece of sulphur stick
materials boiling with soda to cleanse from grease &c. and to discharge as much of colour as possible.
Sulphuric acid in water
Chloride of lime in water
troughs or vats of bleaching solutions in which to rinse materials alternately.
violet bleaching in fumes.
iron spoon containing sulphur.
Experiment shewing sulphur fumes to be a bleaching agent.- used for silk & woollen goods.

INSPECTION WITHOUT NOTICE.

A FIRST VISIT.

IT is over now, and with it the suspense of thinking of the terrors of a "first visit." I wish now that I had thought less, for there has been nothing to worry about. I have gained experience, been highly congratulated, and am encouraged to plod on, believing that what I attempt to do honestly and with common sense will be accepted as the work of an earnest and painstaking teacher.

Let me tell you all about it.

I was at work this morning, just after closing the registers—9.45—in the baby room. The pupil teacher had commenced a lesson on "letter sounds," and although I had, as I thought, given her ample instructions overnight as to what to do and how to proceed, she had gone wrong almost at the very beginning. As a point of fact, she often does go wrong. What am I to do? On this occasion I took the matter into my own hands, and was explaining the sound of the letter *b*, and trying to get the children to imitate my pattern, *bé*, with lips first shut, and then the sound thrust through them by sharply forcing them apart. I could hear *bĕ*, and I abominate hearing the letters mischristened at the commencement of the year, or indeed at any time. I had just about succeeded, when I noticed that Mary, the aforesaid pupil teacher, looked at me with a country blush, and whispered, "The inspector, Miss P——."

I turned, and there across the room, a little to my left, and behind, was a gentleman whom I did not know, and whom I had never seen before. I had been so deeply engaged with letter *b* that I had not heard him enter. He greeted me with a "Good-morning," and seemed pleased that he had taken me unawares. The whisper I had heard from Mary was my introduction, and, face to face with the official stranger, I own I was taken aback. I soon recovered, however; for the experience I had had in a large town as an assistant, where inspectors were numerous and their visits pretty frequent, helped me to cast off my surprise.

I had been in charge of the school—a school in a large country town—for nearly a month, the previous mistress having left at the end of the school year. I had had the arrangement of all the schemes of work, and had introduced a few new things. These had given me much trouble; for the former mistress, a good old soul, who lives retired near the school, and with whom I spend many a pleasant evening, had been very old-fashioned in her ways. She clung to the old notions, letter *a* is *ay*, *b* is *bee*, *c* is *see*, and so on, right through the school in every subject—very simple, and very much out of joint with the times. And the irksome part of it to me is that the teachers are hard to break of these old ways; they think I am young and inexperienced, very much too authoritative, and difficult to please. The parents, too, think the world of the late mistress, and look on me as one who will grow wiser and "know better" when years have passed over my head and turned it gray.

This letter-sounding is one of my "new-fangled notions," and to get it right I have to labour unceasingly, and hold out the prospect, which I often do, of the work becoming lighter by-and-by, when actual reading shall have been reached.

After just a moment of suspense, my inquiring eye asked the inspector what he would have me do; and as he proceeded to take off his hat and coat and hang them on a nail over a picture, I guessed he wished me to "go on."

"I should like to listen to your lesson, if I may," said he on turning round; and as I noticed an accent on "may," I offered him the teacher's chair, and he sat down. I did not master much, or mistress much—which is it, Mr. Editor?—for the children would not attend to me very well. They had more eyes for the visitor than for me, and I had not had sufficient time as yet to break them into my "close attention" method of teaching. I managed, however, to get through the sounds of *b*, *d*, and *p*, and work out the words *bat*, *dot*, and *pit*. The vowels and letter *t* had been previously taught. These I printed on the blackboard, and drew alongside them pictures of (1) a cricket bat, (2) a large dot, and (3) a boy looking down into a stone well. This last I remembered having seen in a school-method book, but I forget which. Anyway, it came in opportunely. Then, as a climax to the lesson, I had my kindergarten alphabet boxes distributed, and with the strips and curves the children made the words on the desks, under Mary's supervision. The inspector was very much pleased with the lesson, and encouraged me to persevere in my system against whatever prejudice I might meet with, and assured me I should by-and-by succeed beyond my expectation. I found, on showing him my reading schemes, that I was teaching exactly on his lines, and he wanted to see the higher classes at their stages of work. This was impossible, as he had spent so much time with me. Reading was over in the other classes, but we managed to find some blackboard work showing word-building, and with this he was perfectly satisfied.

Arithmetic had been commenced, and as we walked from class to class we discussed its teaching, stopping here and there to notice how particular points were dealt with. By-and-by he observed—what I, of course, knew all the time—that only demonstration work was being taken. Every class was being initiated into the mystery of numbers by means of objects. Here we were with Class III. On a raised blackboard, put flat on a desk—quite an improvised arrangement, for in many ways we have to "make shift"—were marbles, apples, pennies, sweets, kindergarten balls, and slate pencils, twelve of each. The teacher was showing, by means of these objects, the method of multiplication, using them in groups of twos and threes. I hope I have made this point clear, Mr. Editor: she was teaching twice and three times tables, going no further with three times than twelve. She was doing it very well, too, scoring a good mark over and over again by asking first one child and then another to perform the operations. The way in which she repeated the exercises, now with the apples, now with the sweets, and afterwards with the marbles, was quite interesting.

I had a few words with the inspector on this method of instruction, and he expressed the hope that when we came to the actual setting down of exercises the children would give satisfaction. I feel sure they will, for I have seen the system worked with far larger classes than mine. Mine, in fact, are only very small classes.

While we were at play, the inspector paid a visit to the boys' school; but when my children had returned he came again, and together we went through the whole schemes of work, which he seemed to remember very well indeed. He had signed them but a fortnight ago. He asked me about my object-lesson specimens, and expressed his doubts as to my being able to procure what I had arranged for. My scheme is purely one which deals with nature study. I have provided for three groups—the Babies, Division II. (Middle), and Division I. (Upper)—and have set out the lessons to be dealt with in the respective months of the year as they come, beginning with January, which is the first month of the school year. For example, holly and mistletoe, snow, melting of ice, the sparrow, and the robin are some of the lessons for January. We have had the lessons on holly and mistletoe, and the melting of ice, and managed to secure the necessary specimens. I am afraid, however, that we shall have to omit that on snow, for as yet we have had none this month, and it is now the seventeenth day. This is the point the inspector raised; but I showed him that such a circumstance could not possibly be helped. I had worked out the schemes as far back as November, when I knew I was going to take charge in January, and at that time I felt sure, judging from the weather of former years, that snow would be plentiful when it was required. He accepted the explanation, and asked me to put it in during any other month, if possible, and make a note of it. This I should do, as a matter of course. As far as the summer and autumn lessons, I pointed out that I was sure of getting my specimens. I am very fond of gardening, and have already procured seeds of several kinds of flowers. I have, moreover, taken lodgings at the house of a jobbing gardener, and surely he will grow a few flowers of his own which I can beg. Sweet-peas and nasturtiums I hope I shall grow in the

schoolroom. I have a nice little arrangement for showing the germination of seeds. It is a box with a fixed glass front. I fill the box with soil, finely sifted, to about an inch and a half from the top, and sow seeds in it, some of which are close to the glass front. When nicely watered, I cover it with a sheet of glass, which keeps the soil moist, and the seeds are up in a few days. Root growth can be watched through the glass front. Hyacinths I have already in glasses which show the same thing. I shall have, too, a hop plant from my native Kent, and when it is in its prime I hope to make the children stare to see my fine clusters of hops. Silkworms' eggs, too, I have; and my method of "striking" geraniums, I know, will be successful. On Saturdays I hope to go on exploration rambles, and bring home some of the produce of a wood not far away, such as mosses, birds' eggs, nests, and acorns. These will form most of my specimens, and my hopefulness in the matter of procuring them drew from the inspector the wish that I might be in every way and altogether successful. At present I have no museum cupboard, and I am afraid I shall have to keep my specimens in my rooms, and carry them to school when they are required.

While we were discussing these points the vicar of the parish came to make a call, and after a few minutes' conversation he took the inspector away. He asked me for the log before he went, and merely signed his name.

I am now free to follow on with my projected courses. I fear no disaster, and am only sorry, as I said at the beginning, that I have brooded so much and so many times about the uncertainty of a successful surprise visit. I shall carefully look out, month by month, for all your splendid hints, Mr. Editor; and if my experience to-day will help my sister mistresses—especially the young ones—to profit by it, as I have profited by others, I shall rejoice at the help I have given them.

STUDIES IN GEOGRAPHY.

BY F. H. SHOOSMITH, B.SC. (LOND.).

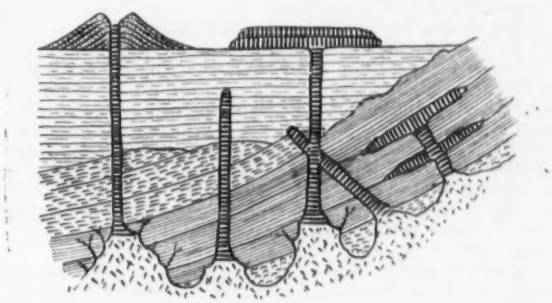
III.—VOLCANOES.

THE definition of a crab as "a little red fish that walks backwards" having been submitted to a famous naturalist, he is said to have remarked ironically, "A very good definition, except for the facts that a crab is not a fish, is not red, and does not walk backwards." Equally "good" is the popular definition of a volcano as "a burning mountain, pouring out flame and smoke, lava and ashes;" for a volcano is *not* necessarily or essentially a mountain, it is *not* burning, and it does *not* send out smoke and ashes.

The all too prevalent confusion and misconception in connection with volcanoes and volcanic action is no matter of surprise when one studies the literature bearing upon the subject—a literature that abounds in indefiniteness, not to say inaccuracy, both of thought and language. One is not disposed to quarrel with such ancient writers as Diodorus Siculus and Strabo when they remark that "the country was once in a burning state, being full of fiery abysses, though now extinct from want of fuel;" but surely no valid excuse can be found for modern authorities who, either from a desire to use language in accordance with popular speech, or in order to obtain an oratorical effect, declare that "it does not require much effort of the imagination to restore the character of the region when these now dormant volcanoes were in full activity, projecting showers of ashes and stones *high into the air amidst flames of fire*, and vast clouds of incandescent gas and steam," and more especially when the writer quoted coolly informs the student, in another section of his work, that *Daubeny's chemical theory of volcanic action was reluctantly abandoned because of the absence of flames*, which should have been theoretically present. It is no answer to this that flames are really sometimes present, for they are never of such a nature as in the slightest degree to justify the italicised language used concerning "flames of fire."

Is it surprising, then, that the scholars in our schools should so often acquire the erroneous notion that a volcano burns as a fire burns, that flames and smoke issue from the crater as they do from a navvy's brazier what time the roads are up, and that volcanic ashes are the cindery residue of a gigantic process of combustion? Are not both the language employed and the models that are used admirably, and indeed inevitably, calculated to impart such ideas, about which the best that can be said is that they are harmless?

The well-known fact that volcanoes vary in size from mere molehills to such giants as Etna, Teneriffe, and Chimborazo—the very smallest having equal claims to the title with the very largest—obviously demonstrates the weakness of the classification of volcanoes as a species of mountain. Etna is without doubt a mountain, as well as what is popularly regarded as a volcano—that is, it is a volcanic mountain; but the existence of many such volcanic mountains does not justify the definition of a volcano as a mountain, burning or otherwise. Such a definition, in the language of the logician, errs by making the connotation or intension of the term too wide, and consequently the denotation or extension too narrow; for *many true volcanoes are certainly not mountains*, whatever else they may be. In essence *a volcano is simply a vent in the earth's crust through which molten matter escapes from the interior;* and, as is sufficiently obvious from the diagram, the "mountain"



which is popularly regarded as constituting the whole of the volcano is merely a heap of ejecta, or material of various kinds that has accumulated around the mouth of the vent. A little consideration will show that the more mountainous this heap becomes, the greater is the obstruction it offers to the further ejection of material. Indeed, the higher volcanic summits are usually extinct, or, if active, give forth only steam, light scoriæ, and dust—for example, the mighty peaks of the Andes, which seldom or never discharge lava, and in which serious explosive action is very rare.

Before dealing further with the nature of this rubbish heap, commonly regarded as the volcano itself, it is advisable to say something of the materials composing it. There is no difference, except a physical one, between the lava that wells out from the crater or other opening, and the true volcanic ashes that, in explosive eruptions, are blown high into the air, the latter simply being fragments of solidified lava. The term "*true* volcanic ashes" is used advisedly, because, for example, the "lava" ornaments sold at Naples are really made from fragments of limestone torn by the explosive forces from the underlying rocks, and scattered all over the sides of Vesuvius. On the other hand, one sometimes hears of "islands of chalk," which are really volcanic islands, consisting chiefly of white silicates, the other constituents of the original lava having been removed by the various atmospheric and other denuding agencies. Lavas are chiefly composed of oxides, especially of silica, and if melted down in a furnace so as to become homogeneous, are converted into a species of glass. Volcanic "ashes," then, being fragments of solid lava smaller than those termed scoriæ, are in no sense the incombustible residue of a burnt mass, but rather fragments of very porous glass.

It is a mistake to suppose that a lava stream is an on-

rushing torrent from which it is difficult for those in its line of direction to escape. Many lava streams are so viscid and sluggish that their motion is more like that of a glacier than of a river, their progress being so slow—a few inches only per day—as to be demonstrable only by careful observation. So viscid is such lava that, should it reach any sudden descent in its course, heavy pendent masses, like those on a guttering candle, hang over and slowly fall. It is equally true, however, that some lava streams are so mobile and liquid that they rush down the slopes almost like streams of water, attaining in a short time a length of several miles. Such lava streams give off much steam, and, whatever may be the truth concerning the actual part played by water in originating volcanic action, there is no doubt that the fluidity of lava varies directly with the amount of water contained. Then, again, what are known as basic lavas are much more mobile than acid lavas, giving rise to jets and fountains, which, when the wind is favourable, are blown out into fine glassy threads, such as are known as Pele's Hair, and which may be imitated by passing jets of steam through the molten slag of an iron furnace.

The shape of the volcanic mound built up around the vent is clearly dependent upon the nature of the ejected material. Trachytic and other viscid lavas build up rounded, dome-shaped masses (for example, the mountains of Auvergne) in a manner which may be imitated by forcing up a viscid pasty mass, such as plaster of Paris, through a hole in a board. In such cases a well-marked crater is not formed, craters being practically non-existent in extinct volcanoes of this type. Conical volcanic mountains can only be formed by the more liquid lavas, or scoriæ, or both—the slope of the sides being dependent upon the degree of fluidity. Mauna Loa (Mauna Kea) has a low, mound-like contour, very different from the steep, truncated cone commonly regarded as typical. Its lava is very dense and very mobile, flowing easily and rapidly; and its minimum angle of flow being small, the cone built up by it has necessarily a very gentle slope. Basaltic lava is very mobile, and, issuing in long streams, has flooded wide areas, forming plateaux such as those of the Outer Hebrides, Idaho, Abyssinia, and the Deccan.

It should not be forgotten that the crater is not by any means always at the summit of the "cone," that of Stromboli, for instance, being a thousand feet lower on the north-west slope. Its size, too, varies with the age of the volcano, that of young ones, such as Monte Nuovo—which, by the way, is a pure cinder cone—reaching, as an inverted cone, from base to summit. It comes as a surprise to many to learn that, during long intervals of rest, the floor of the crater becomes covered with vegetation—thickets and copses, for example, covering that of Vesuvius for four hundred years prior to the eruption of 1631.

Among the many substances other than lava ejected by volcanoes, steam and volatile matter, such as acid gases, are the chief. And here, again, it may be mentioned that the yellow incrustation sometimes seen around a volcanic vent is not necessarily sulphur, being quite as often due to the presence of yellow perchloride of iron. The quantity of steam emitted in violent eruptions is enormous, the vast clouds of "smoke" being really aqueous vapour, or rather water-dust, made up of globular masses, each of which is the product of a distinct outburst. From the heights above the lateral cone of Stromboli the generation of these globular masses of steam can be conveniently watched, the emission of each being preceded by the formation of a huge lava bubble upon the surface of the seething mass. The friction of the uprushing vapour, to say nothing of the scoriæ, upon the air, generates—after the manner of Sir William Armstrong's hydro-electric machine, in which high-pressure steam is forced through an orifice—the electricity that eventuates in the thunder and lightning that burst from the canopy of black clouds, accompanied by torrential warm rains, which, when mingled with the fine volcanic dust, give rise to a soft liquid mud, or even to a scalding, sticky mud-rain. It is this constant bursting of vast steam bubbles that drives up showers of liquid lava which, cooling rapidly, falls as scoriæ and volcanic dust.

Steam is undoubtedly the main explosive in violent eruptions, but possibly other gases co-operate. The presence of actual flames is due to the combustion of such gases as hydrogen and sulphuretted hydrogen; but it must be borne in mind that such flames are faint and lambent rather than luminous, and—unless brilliantly coloured, as they sometimes are, by the presence of metallic oxides—are all but invisible in the daytime. At any rate, they do not rise "high into the air," but are confined to the immediate vicinity of the molten lava. The glare that has given rise to the erroneous ideas concerning the presence of vast, upspringing, luminous "flames of fire" is due to the reflection of the glowing molten lava upon the cloud masses above, much as the glare of the locomotive furnace is reflected from the clouds of steam pouring from the funnel.

The absence of solid combustible material sufficiently accounts for the absence of smoke, such as arises from a coal or wood fire, for example; and hence it is difficult to understand why, in a recent work, an acknowledged authority (following Whymper, who describes the cavernous recesses of Cotopaxi as belching forth smoke) should state that in the eruption of 1877 "a huge column of smoke was ejected which was estimated to be as high as the mountain"—Cotopaxi being 19,500 feet in height—and this more especially as, in his definition of a volcano, the said writer pointedly omits smoke from his list of ejecta. "From the crater are ejected gas, steam, or water dust, and scoriæ or slag, and molten rock."

The too prevalent idea that all volcanic action is violent and explosive is probably due to the fact that Vesuvius has been regarded as typical both in action and in shape, whereas, of course, it is nothing of the kind. Much volcanic action is absolutely free from explosive violence, the lava welling out in a gentle stream, unaccompanied by subterranean rumblings or the ejection of masses of steam. Explosive action is very slight and rare, for instance, in the case of Kilauea, which is practically a gigantic cauldron of molten material. In 1840 lava flowed in enormous quantities from several fissures in it, unaccompanied by earthquake shocks or shaking of the volcano itself; so that at Hilo not the faintest rumbling was heard, and only a slight quivering was felt in the north. In fact, so quiet and calm was this eruption, that the glare from the molten lava, which was so vivid that fine print could be read at midnight forty miles out at sea, was thought to be due to a great jungle fire. Even from Vesuvius lava has sometimes welled almost with the tranquillity of water from a spring; and, generally speaking, violent action is rare in constantly active volcanoes—a long interval of rest producing results similar to those due to fastening down a safety-valve.

Further, while some volcanoes discharge only fragmental material—scoriæ, dust, and broken rocks—others more nearly resemble lava fountains; and where the orifice is large, the lava wells out quietly, and, layer by layer, gradually builds up mountainous masses, the slope of which depends upon the mobility of the molten lava, as has already been seen.

The causes of volcanic action, and the part played by it in the economy of nature, are subjects requiring more space than is here available, and may perhaps be dealt with in a future article. Meanwhile, however, it may be pointed out, in connection with the latter subject, that while the safety-valve simile is at times overstrained, volcanoes are, on the other hand, too apt to be regarded as objects whose action is purely malefic. As a matter of fact, the actual damage wrought by them is comparatively small—sufficient warning being usually given to enable those in danger to escape—and is far outweighed by the advantages accruing in the fertile soils, such as are found in the vineyard-covered slopes of Vesuvius and Etna, and in the counterbalancing by such subterranean activity of the constant denudation of the land by various agencies which would otherwise finally render the globe an impossible habitat for human beings.

Earthquakes are infinitely more destructive than volcanoes; and, as a last point, it may be noted that the destruction is wrought, not by upheavings of the earth's surface, there being nothing of the nature of rising and falling waves, but by vibrations propagated through the solid crust with a velocity that may reach five hundred miles per hour.

The Practical Infant-School Teacher.

OUR MODEL INFANTS' SCHOOLS.

VII.

IN a densely populated neighbourhood of the artisan class of a large and flourishing town there stands the oldest Board School in the district.

It was opened with much educational ardour in March 1873. Fondled in its infancy by a board, consisting of men who, well known then in the political as well as in the religious world, became even better known in the educational; caressed and petted by succeeding boards, each one more progressive in aim than the preceding one; and always under the supervision of able and conscientious teachers, the school maintains a reputation which it is difficult to surpass by schools of the more modern type. Perhaps this is because a firm foundation has all along been laid as regards the training of the children in the infants' department. This has been under the successive charges of more than one mistress who has achieved greatness in her profession; and at the present time there could hardly be found a more soundly educated, a more idealistic, and a more charming lady than she who now sways the sceptre within its walls.

To stand in its large room—a room which corresponds to the central hall of the modern neighbouring schools, and of which a view is shown in Illustration No. 1—is an education in itself. Here are four large classes crowded so closely together as to leave but small floor space for marching and drill, yet working with such ease and quietness that it seems as though there were only one. The teachers are speaking in soft whispers, and the children are responding to them in a modest and quiet tone. To chat with the mistress is an easy task.

The school is famous for nature teaching, and if one did not know this from hearsay, a first glance round the room would declare it to be so. Turn in whatsoever way you will, a cabinet, a case, a museum, or a separate specimen meets your eye. What with beetles, butterflies, animals, and birds, the number must reach into thousands. Here is a small cabinet standing on a table in front of the desk. Its trays contain some very rare and valuable specimens of beetles from the West Indies. The teachers and children know their names, but the writer has no wish to enter on the formidable task of acquiring even a few of them. At the other end of the table a serpent is coiled among the branches of a tree. Between them is a bowl of gold and other fish. On the wall behind is a goodly array of specimens of all kinds; over the clock is a pair of buffalo's horns, near by on the right a case of birds, and on the case a fox. Mr. Reynard has a double duty to perform. In addition to his being used as a model for a lesson, he is something of an attendance officer. Round his neck he carries a card on which is printed, "Class.....gained the highest mark for attendance last week,"—the idea being that whichever class gains that distinction, Reynard belongs to it for a week. It is the "banner" system of some schools; but perhaps this is an improvement, for the smile, the unusual congratulatory smile of the fox, betokens the pleasure which a good attendance at school is sure to bring. Further along is the head of a toucan, a rare and magnificent specimen.

The birds in the cases are singularly well arranged. In some are birds of beautiful plumage, in others of prey, in others songbirds, and in every instance some habit is portrayed. The owl sits secluded on a ruined castle wall, about which he could, if only he had mind and voice, many a tale unfold; the eagle is quietly resting on the summit of a rock watching the scenery below as dawn opens out to day. Some of the birds are in pairs—one on the wing, the other at rest; while some, again, are in the act of feeding. In every instance an attempt has been made to exhibit the specimen under such conditions and circumstances as will command observation and contrast on the part of the child. An instance of this is seen in the two separate specimens of the mongoose and the snake shown in Illustration No. 2. The mongoose is in the act of avoiding the deadly attack, while the snake is poised with head erect, ready to dart its sting into its foe.

The museum proper baffles description. It consists of three immense cases, which occupy the entire wall at one end of the room. The many shelves are full. In one are West Indian field productions—cereals of every kind, sugar-cane showing stem and leaf and flower, cotton, a piece of sago palm, the pith being partly extracted and hanging loosely over the wood. There are cocoanuts in various stages of growth, and photographs of native workers in their quaint garbs, showing the children what a day's work in the broiling sun means to them. The overseer is there keeping them close to their tasks, and the luxurious growth of garden, field, and forest indicates the plentiful supply of fruit we get from the natives' toil. There are guava plants, flowering vines, nutmegs, and all things else, the names of which are best hunted out from a modern geographical reader. The next compartment contains shelves well filled with specimens of animals and birds. The hedgehog and porcupine stand side by side; the chameleon, the stoat, and the flying-fish occupy their places amid glass jars of snakes and reptiles, preserved in spirits of wine; while the sparrow-hawk, the jay, the seagull, the rook, and the humming-bird, with its daintily pretty home, all nestle together in harmless fashion. The next is devoted to the exhibition of the silkworms' and bees' productions, the arrangement of which shows at a glance the grasp the mistress has of natural history, and especially of insect lore. One of the shelves is used as a Japanese home, where are also specimens of the Japs' handicraft and dress.

These are not all, but enough has been said to show the extent and variety of the collection, as well as the success in gathering them, that comes to one whose constant care is to teach from specimens only.

Let us examine the nature scheme of object teaching.

Standard I.—A reptile, a lizard, the chameleon, snakes (poisonous *v.* non-poisonous), a mongoose, a humming-bird, birds of prey.

Classes 1 and 2.—An insect, a bee, a beetle, the spider, the frog, the paddy-bird.

Classes 3 and 4.—A bird, beaks, feet, and claws of birds, the paroquet, the woodpecker, the jay, nests of birds.

Babies.—Lessons from picture book, a bird, laying the tea-table, contrast between birds, animals, and insects; a Japanese home.

The subjects are certainly few in number, but this is a distinct advantage, as the lessons can be repeated and demon-

strated in a variety of ways, the specimens and manner of teaching being changed on each occasion. The lessons, too, necessitate repetition, owing to their length and the thorough

No. 1.—Central Room.

way in which they are taught. In connection with some of the lessons, live specimens are obtained in season; while as regards the lessons on nests of birds, in addition to there being a large variety of nests at hand in the museums, there are also some beautifully executed photographs of English birds' nests, taken under exceptionally happy circumstances, and after exceedingly difficult search. These would make interesting illustrations for reading books or magazines, but as they are copyright, and may some day be used for the purpose just indicated, we are not able to reproduce an example.

The day of visitation is the last but one of the school year, and we are fortunate in being able to listen to a recapitulatory lesson of one of the nature groups. The children are well versed in the year's work. They handle the specimens carefully—one might almost say lovingly—without fear, describe them with great precision, and tell in language clear and distinct the habits and the homes of the animals under consideration. This is the outcome of the twofold use of the specimen—(1) object teaching pure and simple, and (2) conversation. Some of the written exercises are really first class, and occasionally, as in most schools, there have been exceptionally excellent results. The mistress is unstinting in her praises of nature teaching. She thinks there is nothing like it to bring out a child's observation, and build information on a vast number of subjects that are sure to crop up in the conversational lessons. These last certainly do much in aiding the children to gather and store a fund of useful knowledge. It is nice for the children to know that after, say, a nature lesson on Tuesday, a conversational lesson on the same subject will be given on the following Thursday. In the meantime the children will talk the lesson over at the tea-table, father and mother and the older children will join in, and maybe a book will be reached from the shelf and read with some point or other in it bearing on the subject under discussion. It is quite possible that, if father is a well-read man, and careful to see that his child is to hold his own in class, he will find the little one a verse or two on the subject to learn. Cases of this kind have occurred. Happy is the child and proud the teacher to have such valuable adjuncts to their work.

Certain it is that the wide teaching of nature in this school has materially helped the work of other subjects.

As a treat to the children of the Standard class, they have been asked on this particular morning to select their own lesson, as it may possibly be the last of their infant-school career in that subject. Curiously enough, they have chosen arithmetic and dictation. The dictation, an unprepared piece, is as follows:—

"I must tell you that in the milk there are lots of little bits of fat which we call cream."

It is taken from Longman's *First Reader*, which is the book in use. The writing is clear and well defined, and the spelling remarkably accurate. Twenty-two children out of forty-three are quite correct; while the total number of mistakes is fifty-eight, an average of less than two. The stumbling-block was the word "cream." The arithmetic consisted of five problems, spoken in story fashion one by one to the children, then repeated slowly and set down without blackboard aid as the story proceeded.

1. I want to give Tom, Dick, and Harry 48 marbles each. How many marbles shall I want?

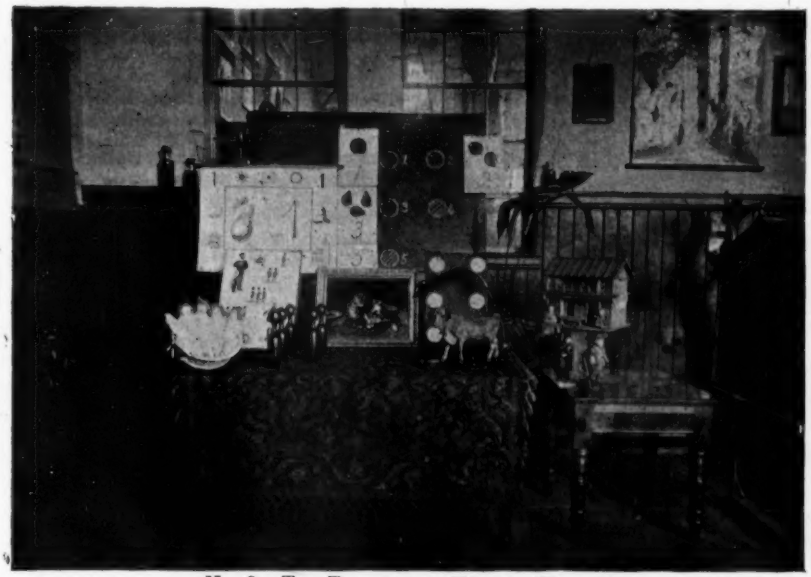
No. 2.—Nature Lesson (Recapitulatory).

2. If I put 37, 13, 9, and 56 apples together in one basket, how many will there be altogether?

3. A girl has 72 beads. If she threads them into four

necklaces of the same size, how many beads will there be in each necklace?

4. Mary plants 35 roots in her garden. Nine of them die; how many grow?



No. 3.—The Teaching of Number (Babies).

5. If 87 boys put 5 pencils each into a box, how many pencils will there be in all in the box?

It will be noticed that in the five sums two of them are exercises in multiplication. The mistress has found out from experience that when four—the usual number—are given, the children come to the conclusion, which is quite a natural one for infants, and indeed older children, that there must be one in each rule they have learnt, and that mistakes are often made through thoughtlessness. She will have none of this, and invariably sets five, one of the rules thus being repeated. To aid the memory—for it is a big task for young children to tackle five problems at one sitting—the children are allowed to put the sign of the rule at the beginning of the lines drawn for the answer. Thus in the fourth sum the minus sign precedes the answer, and the child is not led astray after spending its powers on the three earlier examples. Forty-three children produce two hundred and thirteen correct answers, an average of four and a half. Thirty-one get all sums correct, and when it is noticed that they are all well set down, with good lines and figures, one is bound to remark that the accurate training of the reasoning faculties has been well and truly done.

The writer could not withstand the temptation of testing the mental arithmetic for himself, and by leave of the mistress and the teacher of the class, after being assured by the children that they were not tired, he asked them a number of questions. He commenced with easy exercises in purely mechanical work, proceeded by easy stages to problems involving two calculations, and finished up with one or two little puzzles. The answering was really fine; and the harder the problems were made, the more diligently the children applied themselves to their solution. Snares and traps they were quite accustomed to, and on no occasion were they caught. The last two afforded some amusement; and perhaps the infant mistresses who read this account of a model school will like to try them on their young hopefuls, and see how they acquit themselves.

1. Mary goes into a shop with sixpence. She buys a fourpenny doll, and receives twopence change. By-and-by the shopwoman finds out that the sixpence Mary gave her is a bad one. How much does she lose?

2. Divide sixpence between Sarah and Jane, giving Sarah a penny more than Jane.

The first was answered very readily, but the second caused a little trouble; and the more wrong answers that were given, the more difficult did the task appear to be. As time was getting on, and the writer wished the children to get the problem solved, he took from his pocket fivepence-halfpenny—the only coppers he had—and borrowed the odd halfpenny from one of the teachers who had involuntarily gathered round. He then put the coppers on the desk in front of two little girls, who had been conspicuous for their good answering, and set them the task of dividing them according to the conditions. Still it proved a puzzle, but by-and-by light dawned on one of them, and, heigh presto! it was done. The children, believing the coppers were really meant to be their own, quietly pocketed each her share. The writer did not mind in the least, as the experience he had gained was quite worth the odd fivepence-halfpenny which it had cost him. "But," said the mistress, "it is hardly fair for one of you to have more than the other. What ought you to do with the penny?" Said one of the little girls, "Give it the poor gentleman back."

No. 4.—Word-Building and Reading (Babies).

There is now time for one more lesson, and that interest-

TIME-TABLE—INFANTS' DEPARTMENT, 1901.

MORNING.

Day.	Class.	9 to 9.10.	9.10 to 9.25.	9.25 to 9.30.	9.30 to 10.	10 to 10.35.	10.35 to 10.50.	10.50 to 11.25.	11.25 to 12.
MONDAY.	St.	HYMN, LORD'S PRAYER, AND REGISTRATION OF PUNCTUAL CHILDREN.	Bible Reading.	REGISTERS FINALLY CLOSED.	Reading.	Arithmetic.	RECREATION.	Writing.	Dictation.
	II.				Spelling & Dictation.	Writing.		Reading.	Arithmetic.
	III.				Reading.	Arithmetic.		Word Building.	Writing.
	IV.				Arithmetic.	Reading.		Writing.	Word Building.
	V.				Writing.	Word Building.		Reading.	Arithmetic.
	VI.				Word Building.	Writing.		Arithmetic.	Reading.
	Babies				Letters.	K.G. Games.		Writing & Pencil Drill.	Mental. | Recitation.
TUESDAY.	St.		Bible Story.		Reading.	Arithmetic.		Writing.	Mental Arithmetic.
	II.				Writing.	Mental Arithmetic.		Reading.	Arithmetic.
	III.				Reading.	Arithmetic.		Word Building.	Writing.
	IV.				Arithmetic.	Reading.		Writing.	Word Building.
	V.				Writing.	Word Building.		Reading.	Arithmetic.
	VI.				Word Building.	Writing.		Arithmetic.	Reading.
	Babies.				Letters.	Recitation.		Writing & Pencil Drill.	Mental. | Songs.
WEDNESDAY.	St.		Repetition of Texts.		Reading.	Object Lesson.		Arithmetic.	Dictation.
	II.				Spelling & Dictation.	Arithmetic.		Reading.	Object Lesson.
	III.				Reading.	Writing.		Arithmetic.	,,
	IV.				Writing.	Reading.		Object Lesson.	Arithmetic.
	V.				Arithmetic.	Object Lesson.		Reading.	Writing.
	VI.				Object Lesson.	Arithmetic.		Writing.	Reading.
	Babies.				Letters.	K.G. Games.		Writing & Pencil Drill.	Mental. | Recitation.
THURSDAY.	St.		Repetition of Hymns.		Reading.	Arithmetic.		Writing.	Mental Arithmetic.
	II.				Writing.	Mental Arithmetic.		Reading.	Arithmetic.
	III.				Reading.	Arithmetic.		Word Building.	Writing.
	IV.				Arithmetic.	Reading.		Writing.	Word Building.
	V.				Writing.	Word Building.		Reading.	Arithmetic.
	VI.				Word Building.	Writing.		Arithmetic.	Reading.
	Babies.				Letters.	Recitation.		Writing & Pencil Drill.	Mental. | Songs.
FRIDAY.	St.		Moral Lesson.		Reading.	Recitation.		Arithmetic.	Mental Arithmetic.
	II.				Arithmetic.	Mental Arithmetic.		Reading.	Recitation.
	III.				Reading.	Arithmetic.		Mental Arithmetic.	Object Lesson.
	IV.				Writing.	Reading.		Object Lesson.	Arithmetic.
	V.				Mental Arithmetic.	Object Lesson.		Reading.	Writing.
	VI.				Object Lesson.	Arithmetic.		Writing.	Reading.
	Babies.				Writing.	Singing.		Letters.	Drill. | Singing.

AFTERNOON.

Day.	Class.	2 to 2.10.	2.10 to 2.40.	2.40 to 3.15.	3.15 to 3.25.	3.25 to 4.	4 to 4.30.
MONDAY.	St.	REGISTRATION.	Needlework and Drawing.		RECREATION.	Object Lesson.	Mental Arithmetic.
	II.		,,	,,		Writing.	Arithmetic.
	III.		,,	,,		Singing.	
	IV.		,,	,,		,,	
	V.		,,	,,		,,	
	VI.		,,	,,		,,	
	Babies		Kindergarten.	Recreation.		Singing.	Conversational Less.
TUESDAY.	St.		Tables.	Arithmetic.		Singing.	
	II.		Mental Arithmetic.	Object Lesson.		,,	
	III.		Notation.	Recitation.		Drill.	
	IV.		Drill.	Drill.		Notation.	Writing.
	V.		Writing.	Writing.		Recitation.	Tables.
	VI.		Kindergarten.	Kindergarten.		Mental Arithmetic.	Writing.
	Babies.		Conversational Less.	Writing.		Conversational Less.	K.G. Games.
WEDNESDAY.	St.		Needlework and Drawing.			Hand and Eye.	
	II.		,,	,,		,,	
	III.		,,	,,		Singing.	
	IV.		,,	,,		,,	
	V.		,,	,,		,,	
	VI.		,,	,,		,,	
	Babies.		Kindergarten.	Recreation.		Drill.	Conversational Less.
THURSDAY.	St.		Needlework and Drawing.			Singing.	
	II.		,,	,,		,,	
	III.		,,	,,		Mental Arithmetic.	Writing.
	IV.		,,	,,		Recitation.	Mental Arithmetic.
	V.		,,	,,		Kindergarten.	
	VI.		,,	,,		Word Building.	Recitation.
	Babies.		Kindergarten.	Recreation.		Singing.	K.G. Games.
FRIDAY.	St.		Drill.			Writing.	Word Building.
	II.		Word Building.	Arithmetic.		Drill.	
	III.		Kindergarten.			Word Building.	Tables.
	IV.		,,			Tables.	Word Building.
	V.		Drill.			Arithmetic.	Writing.
	VI.		Writing.	Arithmetic.		Drill.	
	Babies.		Kindergarten.	Recreation.		Conversational Lesson or Story Telling.	

ing class of babies must be seen. The baby-room is a very large one, and admits of two sections of the class receiving instruction at once, without the one interfering with the other. The youngest children are swinging, or riding the rocking-horse—a well-worn creature almost at its last gasp, yet beloved of the tiny ones—or hushing the dollies to sleep, while the older ones are taking a lesson in number. Number is taught entirely from objects, and Illustration No. 3 will show with what great care the lessons are prepared. On the table in front of the class, which is seated on a gallery, is arranged a large assortment of things to handle or point to. They are used in almost every conceivable way. The cow's legs, eyes, horns, etc., are counted, and questions are asked as to how many of each there would be if there were two, three, or four cows. The cats in the picture are used in much the same way. The picture-book, which has taken many years to complete, contains an endless variety of examples which are useful in teaching tables and the easier rules. It is a valuable adjunct to the kind of illustrations usually employed in teaching. The children themselves, for the most part, supply the pictures, and all the classes of the school take an interest in it. Counters too are used. In addition to the articles on the table, the room itself furnishes countless aids. There are a large number of threaded beads, some hanging from the gas pendants, and others festooned on the walls. These beads are of various colours. They are threaded some in ones, each colour alternating; others in twos, threes, fours, etc., the colours again alternating. The beads are also used in colour lessons.

With the idea of showing more work, the teacher of the babies' class voluntarily changed the lesson into a word-making and reading lesson. The materials—again very numerous—were close at hand, and the change was made with rapidity. If the reader will bear in mind that the children themselves do the bulk of the work, a glance at the next illustration (No. 4) will show the method of instruction better than a description. A word, however, must be said about the manner of the teaching of this class, and indeed of the whole school. The voice of the teacher is subdued, and is as far as possible an imitation of the children's. Every sentence is bright, yet spoken particularly slowly and clearly. There was a great display of kindness on the part of the teacher towards the children, and abundant evidence of the children's confidence in the teacher. The children are sometimes purposely left without a teacher, not even a monitor being in charge, for the sole purpose of training them in habits of trust. In this and in many other ways the moral training of the children is closely looked after. A point, which was referred to in "Our Model Infants' Schools —No. 3," is to be seen in practice here. The children are all addressed by their Christian names.

We have to record our grateful thanks both to the mistress and her staff for the kindness accorded to the writer of this article. Not only did they make his visit an exceptionally easy and interesting one, but were it not for the valuable help of the mistress and the teacher of the babies' class on one of the following Saturdays, when the photographs were taken, the story of the school could not have been illustrated. The visit has afforded the writer much pleasure. It has added much to his knowledge of infant-school work, and we sincerely trust that this account of a difficult school will be profitable as well as stimulating to mistresses who are similarly engaged in uphill work.

A few details may be of interest. Accommodation: 401. Average for the past year, new children being constantly admitted: 370. Percentage of attendance: 88. Staff: seven certificated assistants, and five pupil teachers.

A copy of the time-table is appended.

THE PRACTICAL TEACHER'S ART MONTHLY
for April contains—
A Sketch of Sir David Wilkie, R.A., and a Reproduction of his famous Picture
THE BLIND FIDDLER,
Specially described by W. E. Sparkes.

FIRST STEPS IN NUMBER.

With Notes on the Use of Number Cards.

BY JESSIE C. EWING, INFANT MISTRESS, ABBOTSFORD PUBLIC SCHOOL, GLASGOW.

The Initial Difficulty.

"HOW do you teach arithmetic to infants?" "How do you teach subtraction?" are questions which I have sometimes been asked. That there is some difficulty, then, in teaching mental arithmetic to beginners is implied. Let us see where it lies.

I think we scarcely realise how meagre a conception of number a child has to start with. "A whole lot," "a whole handful," express pretty much his notion of plurality in number, though he can express his disappointment, when the number is evident even to him, in "*Just* one." The name "seven" or "eleven" conveys no more definite idea than twenty or a hundred, and the words "greater" and "less" have no meaning at all.

Let us not grudge the time spent in making his way quite clear from the start. Let us begin *at* the beginning. To enable the child to attach a definite value to a definite name, we must at first deal with the concrete. And let it be step by step, point by point. Oh, how often have we failed by attempting too much! The energetic but over-anxious teacher has done all the work, while the children have only wondered. A good corrective is to come into touch with each individual child, and thus see exactly where we are.

Intelligence the First Necessity.

We must carry the child's intelligence with us, and have no rote work. Any result that the child arrives at, however slowly, by the correct application of his own reasoning power, is of infinitely more value to him than any equally true conclusion put into his mouth and repeated glibly by him, but of which he himself has no conviction; and that for two reasons—first, *he* has found it out, and knows it is true; second, he has confidence now in his own power to find it out again, and to find out more by a similar exertion of his reason. And so, too, when a result has been arrived at, it is folly to make him repeat it again and again, in the hope that he will remember it once for all. For the renewed exercise of his power in order to gain the very same result to-morrow, and the next day, and the next, is of far more value than any little item of information merely remembered.

The Sequence of Numbers.

"Well, how do you begin?" With the sequence of the numbers 1–10. With a large ball-frame, moving a ball into *sight* at each number, we count one, two, three, four, etc., to ten—not further; perhaps for some days we may not get beyond six. Sometimes, too, we must stop abruptly and question, "How many?"—"Three." "Are you sure? Come and count."—"One, two, three." "Another one must come and count."—"One, two, three." "We have three balls; here comes another."—"Four." "And another."—"Five." "How many now? Count again." After some work with the class as a whole, there is individual work, each one in turn making an effort, though it be only to count up to three. A small calculator is more convenient for going round the class. An amusing variety is to have the children themselves named according to the numbers.

I find the children much interested in the threading of beads at this stage. They have laces, and beads of two colours in saucers. The colours should be a decided contrast, and the same throughout the class. More colours than two defeat the purpose. Suppose the colours to be yellow and blue: the children thread alternately a yellow and a blue bead till they have ten, when they hold them up for inspection. I need hardly say that this is more easily said than done; but it is a capital exercise, and the children like it.

A stair gives the idea of progression, and of higher and

lower: so we sometimes draw a stair on the board; and we go up the steps, one, two, three, etc., and down the steps, ten, nine, eight, etc. The figures are put on the board, but we do not take much notice of them at first; the children will gradually become familiar with them. Apples, nuts, and marbles are very interesting to think about; but it is even more interesting and profitable to deal with what is before us, and can be handled or touched, as balls, beads, steps, boys and girls.

Adding and Subtracting "One."

The next step is addition and subtraction of 1, prefaced each day by revision of numbers 1–10. Subtraction should be taught simultaneously with addition, and not left till a later period. The child thus early learns the real value and meaning of numbers, and brings his intelligence to bear on the problems put before his mind. "Here are some balls; how many? Count and see."—"One, two, three." "One runs away; how many now?"—"One, two." "Here it comes again."—"Three." "And another comes."—"Four." "It has gone away again." It is a great matter to see the actual going away and coming. This kind of addition and subtraction is at first kept within 6, and later within 10.

As soon as a clear conception of these operations has been gained, we have recourse to the abstract, but with the calculator always in the hand, to be referred to whenever a difficulty occurs. Here comes in the advantage of such concrete things as I have named over fingers. Beads and balls can be withheld, but the fingers cannot be withdrawn at the teacher's discretion, and the tendency is to use them too long.

I fancy I hear the remark, "So you teach by units!" Certainly; how else can I show the relative value of numbers—that seven is greater than six by one, and that five is less than six by one? At a later stage the child will readily perceive that since 5 and 5 are 10, 5 and 6 must be greater than 10; but for a long time he has a very hazy idea of the terms "greater" and "less."

Similar Exercises with "Two" and "Three."

Now we are ready to deal with 2, and the beads come in here again. We thread now two yellow and two blue beads alternately, and thus train the eye to recognise groups of 2. After plenty of practice in adding and subtracting with the balls, there follows similar exercise with abstract numbers. All this is not done in a short time. We keep to groups of 1 and 2 till the children are very well acquainted with these, and the operations are kept within 12 for a long time. Then we proceed to grouping 3 with beads, and adding and subtracting 3 with balls. Ever as each new step has been made clear, we leave the concrete and take to abstract numbers, so that the reasoning power may be developed and strengthened.

A New Help: Number Cards.

I believe very much in grouping, and in training the eye to recognise groups. With this end in view, I have recently introduced into my department number cards (published by Messrs. T. Nelson and Sons), which present the numbers 1–10 in their groups or component parts: 2 and 2 for 4; 2 and 2 and another 1 for 5 (this will later become 2 and 3 in the child's mind, but to emphasise how the numbers increase, I prefer at first to say 2 and 2 and another 1); 3 and 3 for 6; 3 and 3 and another 1 for 7 (which becomes later 3 and 4). These number cards have bright spots on a black ground, and their value lies in the aid given to the child to carry ever with him a mental picture of numbers. They are most attractive and interesting, and the children like to handle and arrange them. Each child receives a set of ten cards, and the first exercise is merely to arrange them in consecutive order. For variety we sometimes give an incomplete set, and let the child say which numbers are lacking. It is also a good exercise to ask a child to bring a certain card to the teacher and have it affixed to its corresponding figure on the blackboard. Subtraction, too, can be easily taught by covering so many spots with the hand, when the child readily perceives how many are left.

As I have indicated, each new number dealt with is resolved into its component parts. After having learned to add and subtract 4, and perhaps 5, the children learn the sequence of numbers up to 20. To learn the sequence of the numbers 1–20, we again have recourse to the stair, and draw attention to the recurrence of the figures 1–9. When the children are somewhat familiar with these numbers in order, we take them two "steps" at a time, and downwards as well as upwards. After this there will be little trouble with the sequence of numbers, though, of course, it must be pointed out that all the "'teens" begin with 1, all the twenties with 2, all the thirties with 3, and so on.

"Doubles" and "'Teens."

At first we teach by units, but there comes a time when we can proceed without them. As a basis for this we learn the "doubles" and the "'teens," thus: 10 and 3 are 13, 10 and 4 are 14, and so on. Teaching now proceeds on these lines. For example: Since 6 and 6 are 12, 6 and 7 must be one more, 6 and 5 must be one less. Subtraction in the same way: Since 6 and 6 are 12, 6 from 12 will leave 6, 5 from 12 leaves 7; and this without going through the operation of taking 5 off, but simply as a matter of reasoning and mental perception. Again, 10 and 4 are 14, 10 from 14 leaves 4, but 9 from 14 leaves 1 more than 4—that is, 5.

Further Use of Number Cards.

The number cards help greatly to make all this quite clear, and they can also be used now in what I might call number-building. A child is asked to show which numbers make 10, and he places together 5 and 5, 6 and 4, 7 and 3, and so on. Then an exercise in subtraction is given. Take 6 away from 10, and 4 will be left. Replace 6, and we have 10 again. Now take away 4, and 6 will be left; so with the other parts. Or the child is asked to show which numbers make 13, and he will place together 6 and 7, 8 and 5, 9 and 4, and so on. An exercise in subtraction follows with these numbers. Take away 8 from 13: 5 will be left. Bring back 8, and we have now 13. Now take away 5 this time, and 8 will be left.

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OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Principal of the Belvedere Pupil Teachers' Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

SCHOLARSHIP EXAMINATION, 1902.
Fourth Month—April.

Work for the Month.

1. *Reading.*—*Quentin Durward*, chaps. xix.-xxiv. (For notes, see page 526.)

2. *Repetition.*—Ten or twelve lines per week.

3. *Teaching.*—Chap. iv., *Scholarship School Management*. The teaching of reading.

This subject, as the most important of school lessons, must receive the closest attention in all its branches. No point has been asked about in the examination which is not explained in the text-book, and the chapter must have the most careful consideration.

4. *Drawing.*—A freehand copy per week from the flat or from a growing plant.

The specimens submitted to me during the month make it necessary to point out again the chief points to be attended to. In the first place, a *small* copy is useless: it must fairly fill a half imperial sheet (15" by 22"). Next, the main features must be sketched in in proper proportion. The manner in which the leading lines are noted and reproduced is a very considerable factor in determining the value of the work. Not until *all* the main curves are finished should any of the detail be inserted. When the sketching is completed, the whole must be lined in with smooth soft lines. The point of the pencil must not be too fine, or the result is a hard wiry line. Several students seem to think that "lining in" is the production of the blackest, thinnest lines they can manage. This is altogether wrong. Flowing curves, bold and beautiful, are required.

5. *Music.*—Chap. iv., *School Music Teacher*. Intervals and pitch.

A question usually occurs on intervals. Care will be needed with the chromatic intervals; the commonest error is in determining the interval. Thus **d–fe**: a student counts **d, r, m, f, fe**, and calls it a fifth, when it is a fourth. An interval is called *augmented* when it contains more semitones than the larger diatonic, and *diminished* when it contains fewer—for example, **d–m** is a major third, **d–ma**, a minor third, **de–ma**, a diminished third; so also **f–l** is a major third, **f–le**, an augmented third. The relative pitch of various notes in different scales is best determined by drawing out a modulator and calculating on that. Care must also be taken with the octave marks.

6. *Needlework.*—The cutting out of a gored petticoat.

7. *Penmanship.*—Ten minutes' daily practice on *The Practical Teacher Copy Book*.

8. *Spelling.*—One hundred words per week, from *Words Commonly Misspelt*.

9. *Composition.*—Write one or two essays each week on such subjects as—"The Causes and Effects of the Crusades," "Tides," "Division of Labour," "The Advantages of a Good Education," "The Coronation," "The Secret of Success," "Who goes a borrowing goes a sorrowing," "Insects and their Uses to Man."

Prepare an analysis. Read up the subject if necessary. Express your ideas in the best possible language. Avoid colloquialisms, slang, or stilted phrases. Do not be afraid of taking a good deal of trouble with this exercise.

10. *English.*—

(1.) Twenty-five roots and meanings per week.

(2.) The grammar of the verb.

(3.) The revival of learning and its effects on the language.

(4.) *Julius Cæsar.*—Act II., Scene 1, line 234 to the end of Act II.

Notes on the Verb.

(1.) *Classification.*—(*a*) Transitive and intransitive. Learn definitions of these terms. Note that many verbs, usually transitive, may be used intransitively, and *vice versa*. Intransitive verbs become transitive if used in a causative sense—for example, he *walked* his horse, he *sailed* the boat.

(*b*) Regular and irregular, or weak and strong. A good definition is necessary, and even with that there are many cases which need independent thought. Some verbs which were originally irregular are now usually regular, but the alternative forms existed—for example, *climb, climbed*, was *clim, clomb*. Many have double forms of the perfect participle—for example, *hung, hanged; mown, mowed; sawn, sawed; sown, sowed; shaven, shaved*. The first form is usually found in the passive voice, the latter in the active.

(2.) *Inflexions.*—(*a*) *Voice.* The active and passive voice must be clearly noted. Only transitive verbs have voice. The passive voice is the form assumed by the verb when the object of the action becomes the subject of the sentence. When a verb which in the active takes two objects is used in the passive, only one object can become the subject. The one which is left is called the *residual object*, as:—

Active—They taught him music.

Passive—He was taught *music*; or, music was taught *him*.

Some grammarians recognise a middle voice, in such cases as, the door *opens*.

(*b*) *Moods.*—Indicative, imperative, subjunctive, infinitive.

The mood which presents most difficulty is the subjunctive, because it is now used very loosely, or not used when it should be. The definition, "The subjunctive mood expresses doubt or uncertainty," is entirely wrong. *I doubt the statement, I am not sure*, are in the indicative mood.

The subjunctive mood is used to express a mere hypothesis, something thought of by the speaker not as existing, but simply as a basis for another statement. It is confused generally with the conditional use of the indicative. Thus, if I say, "I shall stay at home if it is raining," the latter clause is not a supposition but a condition, and is not subjunctive mood; but if I say, "If it were to rain, I should stay in," the former clause is a supposition, and is subjunctive mood. The conjunctions *if, though, unless, lest, that*, etc., usually, but not always, precede the subjunctive mood. The student must study very carefully the examples met with in the English; for example:—

> If my name *were* liable to fear.
> If I *were* Brutus.
> Then, lest he *may*, prevent, etc.

All these suppose something which does not exist, and are therefore subjunctive mood.

Note the uses of the infinitive mood:—

(i.) As principal verb after auxiliaries—shall, will, may, etc.

(ii.) As verbal noun. *To err* is human.

(iii.) To denote purpose. I will go *seek* the king.

(iv.) To qualify nouns. Bread *to eat*, water *to drink*, house *to let*, etc.

(v.) To limit adjectives. Easy *to see*, quick *to learn*, ready *to go*, etc.

(*c*) *Tenses.*—The following classification should be adopted:—

Past	Perfect.	I had written.
	Progressive.	I was writing.
	Imperfect.	I wrote.
Present	Perfect.	I have written.
	Progressive.	I am writing.
	Imperfect.	I write.
Future	Perfect.	I shall have written.
	Progressive.	I shall be writing.
	Imperfect.	I shall write.

(3.) *The Gerund.*—The gerund is the verbal noun in *-ing*, which, while it takes the place of a noun, retains the power of the verb, and if the verb is transitive takes an object—for example, "on entering the warehouse." *On* = preposition governing the gerund *entering*. *Warehouse* = objective case governed by the transitive gerund *entering*.

(Notes on auxiliary and defective verbs will be given next month.)

Notes on Points asked about.

(1.) *I would it were my fault to sleep so soundly.* This is a complex sentence.

(*a*) Subject = I.
Predicate = would.
Object = it were, etc.

(*b*) Subject = it.
Predicate = were my fault.
Enlargement of subject = to sleep so soundly.

(2.) *The abuse of greatness is*, etc. Brutus's meaning is: "The great danger is that if we give Cæsar more power, that power may not be used judiciously and with proper sympathy for his subjects. The greater power a man possesses, the greater need is there for him to use it with great caution."

(3.) *And since the quarrel*, etc. "Since we cannot find any adequate grounds for assassinating Cæsar for what he *has* done, we must argue thus, that if we allow him to increase his power he *may* do wrong, and, therefore, we will kill him, in order to prevent the possibility of his tyranny."

(4.) *Get you to bed. You* is used reflexively in this case.

(5.) *Between the acting*, etc. "From the time when some dreadful deed is first contemplated till it is actually committed, the whole interval is like a hideous dream. The whole man resembles some little kingdom in a state of insurrection, for the mind ('Genius') is endeavouring to force the body ('mortal instruments') to carry out a decision from which it revolts with repugnance."

This is a well-known truth, beautifully expressed. Although the mind of a man may determine that some murder is necessary, the natural feelings of the body tend to prevent its execution.

(6.) *No not an oath*, etc. This speech of Brutus requires attention, as illustrating his character. Cassius knows full well the danger they are running if either of the conspirators should reveal the plot. Brutus, who regards the movement from the standpoint of lofty and noble patriotism, assumes that the others are as single-minded and honest as himself, actuated by the

same desires for the general good, and destitute of any personal animus against Cæsar. Yet "all the conspirators, save only he, did that they did in envy of great Cæsar." The same spirit is shown below when Cassius proposes (wisely, as after events proved) to include Antony in the assassination. Brutus, the student and dreamer, overrides the practical and shrewd man of the world.

(7.) *And that were much he should.* All Antony can do is to kill himself for Cæsar's sake; and as he is a man particularly fond of life and its pleasure, that would mean very much for him, and he is not at all likely to do it.

11. *Geography.*—

(1.) Revise in detail Spain, Portugal, Italy, and the Balkan Peninsula.

(2.) Australia: towns, people, states, and government.

For revision use note-books and sketch-maps freely. Read as widely as possible, especially any books of travel, etc., bearing on the countries. As it is impossible to understand the constitution of Italy and the Balkan States without a glance at their history during the last century, the following notes should be carefully read up:—

When the Roman Empire fell to pieces, the various provinces of which it had been composed made themselves independent states. Italy was no exception to this, and from this time till 1861 was a very good example of the impotence into which a country falls which is divided against itself. At the end of the eighteenth century Italy was divided as follows:—The House of Savoy held *Sardinia* and *Piedmont*; the Austrians, *Milan* and *Tuscany*; Charles the Third was king of the *Two Sicilies*; his brother Philip, *Duke of Parma*; the *Papal Territory* occupied the middle portion of the peninsula. *Modena* and *Genoa* were under the protection of France.

Early in the nineteenth century a feeling of exasperation against the tyrannies of the petty rulers in Italy broke out. There was also a strong hatred of the Austrians, who held Venice and Lombardy. Many "Carbonari" revolutionary societies sprang up, but no serious attempt was made to unite Italy under one ruler till 1848, and the attempt was then ineffectual.

In 1859, Cavour, the Sardinian Prime Minister, the "brain" of the movement, declared war against Austria, and the battles of Magenta and Solferino were won. The states of central Italy voted their union to the kingdom of Victor Emmanuel of Savoy, and were annexed in 1860.

Shortly after, the people of southern Italy revolted against the King of Naples, and Garibaldi led an expedition to their assistance, with the result that the whole of southern Italy was added to the kingdom.

In February 1861, the first Italian Parliament met at Turin, and Victor Emmanuel was proclaimed King of Italy. In 1866, Venice was taken from Austria; and in 1870, when the king occupied Rome, the whole of Italy was at last free and united.

The Balkan States.—In 1800, the Turkish Empire in Europe stretched from Cape Matapan to the southern boundaries of Austria and Russia.

In 1830, Greece attained its independence after a long and severe struggle, which, but for British assistance, would have failed.

In 1875-7, Russia attacked Turkey, defeated the armies sent against them, and advanced nearly to Constantinople.

In 1878, a conference was held at Berlin, attended by representatives from Russia, Turkey, Germany, Great Britain, France, Austria, and Italy, to adjust matters between the powers. Its decisions are most important:—

(1.) *Roumania* and *Servia* were made independent kingdoms.

(2.) The principality of *Montenegro* was declared free, and additional territory given to it.

(3.) The province of *Bessarabia* was given to Russia.

(4.) Parts of *Epirus* and *Thessaly* were given to Greece.

(5.) *Bulgaria* became a self-governing though tributary principality.

(6.) *E. Roumelia* (since joined to Bulgaria) received many concessions.

(7.) *Bosnia* and *Herzegovina* were to be occupied and administered by Austria.

(8.) A large part of *Armenia* and *Georgia* south of the Caucasus was ceded to Russia.

(9.) The island of *Cyprus* was handed over to England.

Those decisions reduced Turkey in Europe to a small part of its previous size.

Australia.—The student should know something of the history of the various colonies of Australia, in order to understand their mutual relations. The following points should be committed to memory:—

1. *New South Wales.*	First settlement at Sydney—convict station	1788
	Representative government granted	1842
	Responsible government granted	1855
2. *Victoria.*	First settled by the brothers Henty	1834
	Constituted a separate colony	1851
	Discovery of gold at Ballarat	1851
	Responsible government granted	1855
3. *Queensland.*	First settlement at Moreton Bay—convicts	1824
	Gold discovered	1858
	Made separate colony with responsible government	1859
4. *South Australia.*	First settlement—*not* convict, but free settlers	1836
	Representative government granted	1856
5. *West Australia.*	First settlement by free colonists	1829
	Elected representatives allowed on the council	1868
	Responsible government granted	1890
6. *Tasmania.*	First settlement—convict station	1803
	Made independent of New South Wales	1825
	Responsible government granted	1856

The Commonwealth.—From the above it will be seen that up to the end of the century there were six separate colonies, each with its own government and laws. As long as the settlers were separated from neighbouring colonies by vast expanses of land there was little to object to in this arrangement, but when the settled districts expanded till they met with others, the different laws which obtained in each led to much inconvenience. To have six separate postal systems, military forces, financial systems, import and export duties, immigration laws, marriage laws, bankruptcy laws, etc., in one country was bound to be productive of many disputes. The idea of combining under a central government, or federating, suggested itself as a means to obviate this friction. Conferences were held in 1887, 1890, 1891, 1897, 1898; and after much discussion on the many difficult points which arose, the people of the various colonies determined to apply to the English Parliament for power to unite. The Federal Enabling Bill was passed in 1900, and the Commonwealth of Australia came into being on January 1, 1901. Under this new constitution each of the States (as they are now called) retains its own parliament to decide on local matters, but such questions as affect the country as a whole are referred to the central government. The latter is constituted as follows:—

(1.) The King—represented by the Governor-General—Earl of Hopetoun.

(2.) The Upper House or Senate—consisting of six members from each of the six states.

(3.) The House of Representatives—consisting of members elected by the people, in the proportion of one for every 50,000.

The more densely populated states thus send a greater number of representatives to the Lower House than the others, but all send the same number to the Senate.

The constitution closely resembles that of Canada, but there is one important difference. In the Dominion, the central parliament determines the powers of the local parliaments; in the Commonwealth it is the other way about: the local parliaments decide what shall be referred to the central body.

The first parliament was opened by the Duke of York in May. The capital has not yet been selected, but it is to be in New South Wales, and not within a hundred miles of Sydney. Nearly the whole of the first session was taken up in settling the very complicated question of federal finance.

12. *History.*—Edward I. to Richard II. Chief points:—

Edward I.—(1.) The reduction of Wales and the war with Scotland. Prepare a genealogical table to illustrate the rival claims to the throne of Scotland.

(2.) The legal reforms. These are most important. Edward was the greatest king since the time of Alfred. His two great aims were (*a*) the reduction of the whole island under one rule, and (*b*) the establishment of a sound system of law and order. Note the series of wise laws, etc.—

1273. Commercial treaty with Burgundy fostering the woollen manufacture.
1278. *Statute of Gloucester*, which regulated the powers of the county courts. The *Quo Warranto* writs issued to investigate the grounds on which barons held their estates.
1279. *Statute of Mortmain*, curtailing the power of the church, by preventing persons from leaving lands to the church, whereby the king suffered in revenue.
1283. *Statute of Merchants*, enabling traders to punish debtors.
1284. *Statute of Wales*, placing that country under English laws.
1285. *De Donis Conditionalibus*, instituting the law of entail.
1285. *Statute of Winchester*, providing for national defence and local administration of justice.
1285. *Circumspecte Agatis*, limiting the power of the church.
1290. *Quia Emptores*, to prevent subinfeudation.
1295. *The Model Parliament*, the first perfect parliament.
1297. *Confirmatio Chartarum*, the solemn reiteration of charters previously granted.
1297. *De Tallagio*. By which the parliament claimed the sole right of levying tallages or taxes.
1300. *The Reform of the Law Courts.* After the Norman Conquest the Magnum Concilium acted as the supreme law court; but as that body met only three times a year, it was soon overwhelmed with business, and gradually the Curia Regis took its place as a law court. The institution of Itinerant Justices by Henry the Second lightened the work to some extent, but by Edward the First's time it had again become unmanageable. He solved the difficulty by creating proper stationary courts: (1) The King's Court, (2) The Chancery Court, (3) The Court of Common Pleas—each with an adequate number of judges.

Edward II.—The favourites. Lords Ordainers. Battle of Bannockburn and Scottish independence.

Edward III.—The war with France. Note particularly the causes—

(1.) The alliance between the Scotch and French.

(2.) The attempt of the French to seize the fertile district of Guienne.

(3.) The wool trade with Flanders. The staple export of England was wool, and the best customer was Flanders. The Flemings had risen against the Duke of Burgundy, and the French King had been appealed to to crush the insurrection. If he did so, England would assuredly lose its best market.

(4.) The constant quarrels between French and English sailors in the Channel.

Edward's claim to the French throne was a pretext—a result rather than a cause of the war. He put the claim forward, against all law and precedent, to attract to his side some of the discontented barons in the north of France.

Richard II.—The Peasants' Revolt, Lollardism, the Lords Appellant. Note the causes of the Peasants' Revolt:—

(1.) The system of villeinage, under which a man was bound to the soil, and could not rise. Much land was occupied on personal tenure—that is, the tenant had to work for his landlord a certain number of days per week.

(2.) The scarcity of free labourers, increased by the Black Death.

(3.) The Statutes of Labourers, which made the lot of the villein more oppressive than ever.

(4.) The extortionate market dues, which took away all profit from the sale of produce.

(5.) The teaching of Wycliffe, or rather his "poor priests," who to his Lollardism added a socialism of their own.

(6.) The general discontent at the heavy taxation.

(7.) The manifestly unjust Poll Tax.

Demands (which were refused).—(1) Abolition of villenage; (2) land to be let at 4d. per acre (money payment instead of personal service); (3) abolition of market tolls and dues.

Results.—Serfdom gradually died out. Money rent took the place of personal service.

13. *Arithmetic.*—Division into proportional parts, partnership, mixtures, averages, and percentages. There is not much difficulty with these sums if the explanations in the text-book are carefully followed. All the exercises should be worked, or the student should at least satisfy himself that he *can* work them. If any difficulty is experienced, the sum should be sent up for solution.

14. *Algebra.*—Work the examples on harder equations (Hall and Knight). Note the solution of such equations:—

(i.) $\dfrac{x+5}{x+4} - \dfrac{x-6}{x-7} = \dfrac{x-4}{x-5} - \dfrac{x-15}{x-16}$.

$\dfrac{(x+4)+1}{x+4} - \dfrac{(x-7)+1}{x-7} = \dfrac{(x-5)+1}{x-5} - \dfrac{(x-16)+1}{x-16}$.

$1 + \dfrac{1}{x+4} - 1 - \dfrac{1}{x-7} = 1 + \dfrac{1}{x-5} - 1 - \dfrac{1}{x-16}$.

$\dfrac{1}{x+4} - \dfrac{1}{x-7} = \dfrac{1}{x-5} - \dfrac{1}{x-16}$.

$\dfrac{-11}{(x+4)(x-7)} = \dfrac{-11}{(x-5)(x-16)}$.

$x^2 - 3x - 28 = x^2 - 21x + 80$.

$18x = 108$

$x = 6$.

(ii.) $\dfrac{x}{a} + \dfrac{y}{b} = 1$. $\qquad \dfrac{x}{3a} + \dfrac{y}{6b} = \dfrac{2}{3}$.

Work in fractional form. Multiply the second equation by 3.

$\dfrac{x}{a} + \dfrac{y}{b} = 1$. $\quad \dfrac{x}{a} + \dfrac{y}{2b} = 2$. Subtracting

$\dfrac{y}{2b} = -1$. Therefore $y = -2b$, etc.

15. *Euclid.*—Finish Book II., with four deductions per week.

16. *Languages.*—First two paragraphs *Life of Epaminondas.* In French read as much as possible. (As it is impossible to set work to suit all students in this subject, those requiring assistance must write direct for it.)

17. *Elementary Science.*—Radiation, reflection, refraction, analysis of light, colour disc, spectrum.

18. *General Information.*—Answers to questions sent up.

(1.) What is the meaning of *Worth your while?*

While, in this phrase, is the Anglo-Saxon word = time. It exists in such cases as "for a while," "woe the while," etc., and as a dative case in the word *whilom*.

(2.) What is meant by the *Law of Entail?*

When land is entailed it passes from father to son or the next heir, and the owner has no power to dispose of it otherwise by will. The custom was instituted in 1285. The object is obvious. It prevents a spendthrift parent from ruining his son. The entail can only be broken by the joint consent of the holder and the next heir, the latter being of full age.

(3.) *Why can the reflection of stars be seen in a well in the daytime?*

There are, of course, as many stars in the sky in the daytime as at night, but they are rendered invisible to the unaided eye, because their feeble light is entirely overwhelmed by the brighter rays of the sun. But a person standing at the bottom of a deep well or mine shaft can see them, because the rays of the sun are cut off, and do not overwhelm their light.

(4.) *Why do stars twinkle?*

The stars are at such vast distances that the number of rays of light which reach the eye is very small—possibly only one or two. Anything which deflects these one or two rays renders the star invisible. The different parts of the atmosphere are of different densities, and as when a ray of light passes through media of different densities it is refracted or bent from its course, so the star rays are deflected and lost. The star thus appears and reappears rapidly, and this is called twinkling. The sun and moon do not twinkle, because there are so many rays that if a few are deflected we do not miss them.

(5.) *What is the origin of the Barber's Pole?*

The history of signs is a very interesting study. Before the days when every one could read, it was useless to put a name over a shop, but some object connected with the trade carried on was hung out. A servant would not be directed to Mr. A——, No. 20 B—— Street, but to "The Sign of the Dragon," "The Sign of the Golden Fleece," etc. The pole placed before a barber's shop refers not so much to the hairdressing as to a business which has now happily passed into better qualified hands—namely, blood-letting, which in early time was a recognised part of a barber-surgeon's business. The coloured bands on the pole signify the bandages—white and red—used.

(6.) *Who were the Jesuits?*

A religious order—the Society of Jesus—founded by Ignatius de Loyola. In its early days the Jesuits followed as closely as they could the example of Jesus, possessing no property, but going about doing good. They were active missionaries, and carried the Christian religion into the wilds of America and the Far East. But when they began to interfere in political matters they became a nuisance, and were expelled from several of the Continental nations. They were the leaders or agents in most of the plots in Elizabeth's reign.

Questions for Competition.

The answers to these questions are marked gratis. They should be sent to Mr. A. T. Flux, The Bays, Belvedere, Kent, with a stamped addressed envelope for return. A prize of One Guinea is offered to the student scoring the highest percentage of marks during the year.

1. What were the Cinque Ports?

2. Use each of the following in an appropriate sentence:—calibre, ennui, canaille, derogatory, flagrante delicto, bizarre, alibi.

3. What is the Latin inscription on a penny? Give the meanings.

4. Explain the following phrases:—
   (*a*) Caviare to the general.
   (*b*) Rule of thumb.
   (*c*) Sour grapes.
   (*d*) As mad as a March hare.
   (*e*) The cup that cheers but not inebriates.
   (*f*) To catch a Tartar.

5. What nicknames have been applied to the various parliaments, and why?

6. Which are the ten largest towns in England, according to the census of 1901?

7. Explain why different places have different times. If it is 4.30 p.m. at a place when it is 11 a.m. at Greenwich, what is the longitude of the place?

8. A milkman had a large can of milk, and a 3 and a 5 pint measure. He wished to supply a customer with 4 pints *at once*. How could he do it?

Questions on the Work for the Month.

(The answers to these are marked and returned for a nominal fee of one shilling.)

1. Write as specimens of copy-setting:—
   Large Hand—*Hieroglyphics.*
   Small Hand—"*'Tis better to have loved and lost*
   Than never to have loved at all."

2. With what apparatus other than maps, blackboard, and desks should a school-room be supplied?

3. Write an essay on:—
   "The heights by great men reached and kept
   Were not attained by sudden flight;
   But they, while their companions slept,
   Were toiling upward in the night."

4. Classify the pronouns.

5. Analyse the following, and parse words in italics:—
   "You know his means,
   If he *improve* them, may well stretch *so* far
   As to annoy us all; *which to prevent*
   Let Antony and Cæsar fall together."

6. Give in your own words Brutus's reasons why the conspirators should not swear an oath.

7. Say what you can of the *native* fauna and flora of Australia.

8. Describe, with a sketch-map, the basin of the Rhine, *or* the Elbe, *or* the Danube.

9. Explain clearly the causes of the Barons' War in Henry the Third's reign.

10. What were the chief provisions of Magna Charta? In what way was it weak?

11. (*Boys*) Work the following:—

(i.) $\dfrac{\dfrac{a+p}{a-p} - \dfrac{a-p}{a+p}}{\dfrac{a+p}{a-p} + \dfrac{a-p}{a+p}}$. Ans. $\dfrac{ap}{a^2+p^2}$.

Simplify—

(ii.) $\dfrac{x^3-a^3}{x^3-a^3}\left(\dfrac{x^3}{x+a}+a\right) + \dfrac{x^3-a^3}{x^3+a^3}\left(\dfrac{x^3}{x-a}-a\right)$. Ans. 2.

(iii.) $\dfrac{\dfrac{a^2+b^2}{b} - a}{\dfrac{1}{b} - \dfrac{1}{a}} \times \dfrac{a^2-b^2}{a^2+b^2} \times \left(\dfrac{a+b}{a-b} + \dfrac{a-b}{a+b}\right) \times \left(\dfrac{a}{a+b} + \dfrac{b}{a-b}\right)$. Ans. 1.

12. Distinguish between heat and temperature. What is meant by "capacity for heat," "mechanical equivalent of heat," "conductivity"?

SPRING EXAMINATION, 1902.

The following questions may be found useful for revision. Next month we shall start a new course, with full hints on study, advice as to text-books, etc.

Elementary Science.

Candidates.—

1. The length of a column of mercury is one metre, and the area of its cross section is one quarter of a square centimetre. The specific gravity of mercury is 13½. What is the weight of the column in grammes?

2. A sheet of cardboard of irregular shape lies on a table. How, by pushing it partially over the edge of the table, can you roughly determine the centre of gravity?

3. A horse has to tow a barge along a canal. Will it be best to use a short or a long tow rope? Give reasons for your answer, and illustrate it by a diagram.

4. Two boys push against a gate in opposite directions. One boy pushes near the middle, and the other near the end farthest from the hinge. Explain why one boy has an advantage over the other.

5. A glass funnel is entirely immersed in water, with its mouth downwards. A finger is placed tightly upon the upper end, and the funnel is gradually raised out of the water. Why will the funnel be found to be full of water? How far can it be raised before the water will run out? What results will be obtained if the finger is not placed upon the funnel until the latter is half out of water?

6. A tube of the shape U, with both ends open, is fixed in an upright position. First, we pour in enough mercury to fill the curved part, then we pour 20 cubic centimetres of water into one arm, and 50 cubic centimetres of water into the other. Draw a diagram to show the positions which the liquids will take up, and give any explanations you may think needful.

7. Two iron bars of equal length and thickness are fastened together (without overlapping) so as to make a figure of the shape T. Where is the centre of gravity of the figure?

8. Weights of 18 ounces and 7 ounces are joined by a thread which passes over a fixed pulley. The larger weight rests on a table at a point underneath the pulley; the smaller weight hangs in air. What is the pressure (1) on the table; (2) on the pulley?

9. The nets over the heads of the passengers in a railway carriage are piled up with parcels. From which side are the parcels most likely to fall (1) when the train is starting; (2) when it is stopping? How do you explain the result?

10. Which way is the lower valve of the common pump made to open? What is the force that sometimes keeps it open? What is the force that sometimes presses it shut?

First Year.—

1. On a cold morning ice is found on the inside of the windows of a room. How is the fact to be explained? Why is not the ice found also on the walls?

2. A thermometer stands in a test-tube containing hot water. A second thermometer is taken out of a vessel of melting ice in which it has been standing, and is placed in the test-tube beside the other thermometer. What will be the behaviour of the two thermometers? How do you explain the results described?

3. A thermometer is placed in the steam arising from a boiling kettle. What temperature will it probably indicate? In what circumstances may steam be obtained (1) at a temperature lower, (2) at a temperature higher than the temperature mentioned in the first part of your answer?

4. An electric lamp which is fixed under water sends out its rays in all directions. Draw a diagram to show (1) the paths of those rays that emerge from the water; (2) the paths of those rays that reach the surface, but do not emerge from the water.

5. Place a prism—say, a drop from a glass chandelier—close to your eye when inside a room, and look through the prism at a window. What phenomena may be observed? How do you explain these phenomena?

6. A bright metal vessel filled with ice is brought into a hot room. What result, besides the melting of the ice, will be observed? How do you explain the result in question?

7. One jar contains a pound of ice, and another a pound of ice-cold water. A pound of water at a temperature of 90° Centigrade is poured into each jar. What will be the temperature of each mixture? How do you account for the difference between the two results?

8. An empty barometer tube which has been standing in a room at a temperature of 15° Centigrade is totally immersed in water at a temperature of 30° Centigrade. After a time ice is added to the water, until its temperature is reduced to 0° Centigrade. Describe the change in volume which the air in the tube will undergo. The open end of the tube is always kept lower than the closed end.

9. A beam of light falls obliquely upon the surface of water. Draw a diagram to show the course of the reflected ray. What can you say about the brightness of the reflected ray (1) when the beam of light falls nearly perpendicularly upon the surface of the water; (2) when it falls very obliquely?

10. Two things happen to a beam of sunlight when it is passed through a prism. What are they? What result is obtained if the sunlight, before reaching the prism, has to pass through a piece of red glass?

Second Year.—

1. What are the bubbles that appear when a bottle of soda water is opened? Why do they appear upon the opening of the bottle?

2. A glass funnel is placed mouth downwards over an ordinary gas burner, on which it does not fit closely. The gas is turned on, and a lighted match is put to the top of the funnel. How and why does the flame which is produced differ from the flame of an ordinary gas jet?

3. A lesson on mercury has to be given to scholars whose average age is about twelve years. To what properties of the metal should the attention of the class be directed?

4. One end of a magnetised bar is dipped into iron filings. Draw a diagram showing the bar "end on" and the iron filings adhering to it. Give any explanation that seems necessary.

5. A strong bar magnet is placed on a table; it lies in the magnetic meridian with its north-seeking pole towards the north. What positions near the magnet should be chosen for a compass (1) if the north-seeking end of the compass needle is to point to the magnetic north; (2) if the south-seeking end of the compass needle is to point to the magnetic north? Illustrate your answer by a diagram.

6. Mustard seeds are grown on wet flannel. After a time the plants are found to be heavier than the original seeds. Whence have the materials necessary for the increase in weight been obtained? Name the materials in question.

7. What results may be observed when a piece of sodium is thrown into water? How do you account for the facts that you describe?

8. A piece of marble is placed in a very hot fire for an hour or two; it is taken out and allowed to cool; then water is poured on it. What changes in the stuff may be observed? What chemical actions accompany the changes in question?

9. The end of a knitting needle, when brought near to one of the poles of a compass needle, attracts the pole in question. How can we ascertain whether the knitting needle was magnetised originally, or whether it merely became magnetised when brought near to the compass needle?

10. Where are the magnetic poles, and where is the magnetic equator? How would you expect a dipping needle to behave if taken to these places?

CORRESPONDENCE: RULES.

To ensure an answer in the next issue, queries must be sent by the 15th of each month.

Name and address of sender, with coupon of current number of THE PRACTICAL TEACHER (and *nom de plume* if desired), must be enclosed.

As a rule, all replies will appear in the Correspondence Column; but any one desiring an immediate reply may obtain it by enclosing a stamped addressed envelope.

All communications and queries with regard to the PUPIL TEACHERS' AND SCHOLARSHIP COURSE should be addressed to "Mr. A. T. FLUX, The Bays, Belvedere, Kent."

ANSWERS TO CORRESPONDENTS.

Omega.—14/20. A very fair drawing, but the lining-in is weak. The lines are not smooth. The veins on the leaves should thicken as they approach their base.

Will *Miss L. Austen* please send address to me, as I cannot return papers?

H.J.T.—Express in words the following truths:—

If $a : b :: c : d$, then $a : c :: b : d$; $a \times d = b \times c$; $\frac{b \times c}{a} = d$.

Ans.—If four quantities are in proportion, then the first bears the same relation to the third as the second does to the fourth; the product of the extremes is equal to the product of the means; the product of the means, divided by the first, is equal to the fourth.

Doubtful.—Yes, there is a difference. Gold is weighed by troy measure, feathers by avoirdupois. You cannot compare by saying one is 12 oz. and the other 16 oz., since the "ounces" are not the same. The only common term is grains. 1 lb. troy = 5,760 grains, 1 lb. avoir. = 7,000 grains.

French.—See note above under the subject. If you will let me know exactly your difficulties, I will assist you.

(*Other correspondents answered by post.*)

KING'S SCHOLARSHIP.—The list has been published much earlier this year than usual, probably because the order of merit has been abolished. The arrangement in divisions will evidently force the training colleges to take other matters into account; for if a college has, say, eight places left after accepting all in higher divisions, while there are perhaps twenty of its candidates in the division in question, it is evidently unjust to admit them because their names begin with the early letters of the alphabet.

We hope that all of our readers who entered have come out near the top.

NOTES ON "QUENTIN DURWARD."

(*Continued.*)

(*N.B.—The pages refer to the New Century edition of the novel published by Messrs. T. Nelson and Sons, 35 Paternoster Row, London, E.C. 2s.*)

CHAPTER XVIII.

Page 200. *Hochheim* and *Johannisberg.* Two villages on the Rhine famous for their wines.

265. *Ecorcheurs.* Flayers.

267. *Hierarchy.* Rulers of the church.

268. *Faitours.* Traitors.

CHAPTER XIX.

269. *Load-star.* Leading star or centre of attraction. A.S., *lædan*, to lead.

270. *Romaunt.* A romance or poem. Scott mentions two written black-letter editions of the Old English poem mentioned here. It is included in Hazlett's *Remains of Early Popular Poetry of England* (1866).

Letters blake. "Black letter" is a term applied to the Gothic or German type because of its black appearance.

271. *Guerdon.* Reward.

Hive of drones. The monastery. The term is applied to the monks because in the speaker's opinion they are lazy and idle.

273. *Pleached.* From Lat. *plecto*, I weave. A pleached walk is one with the branches of the trees on either side interwoven.

Castellated. Built in the form of a castle.

Postern-door. A small door only large enough to admit one person at a time. Lat. *posterus*, behind.

276. *Church of St. Lambert.* The old cathedral of Liege. The interest in Quentin's appearance was caused by the belief that he was an emissary of Louis, who had been privately stirring up the citizens to revolt against the Duke of Burgundy. The hero was, of course, unaware of the king's secret plottings with the citizens.

278. *Sapperment.* An exclamation of surprise.

279. *Temporise.* To delay giving a final decision or explanation.

Stadthouse. The Town Hall.

280. *Butchers' incorporation.* All trades in the Middle Ages were controlled by guilds or corporations.

Brantwein. Brandy.

281. *Eclaircissement.* Explanation or enlightening.

Vivat. Shout of goodwill. Lat. *vivat*, may he live.

Belwethers. Leaders. The sheep or wether which leads the flock bears a bell, the sound of which the sheep follow blindly.

283. *Guilder.* A Dutch coin worth about 1s. 8d.

284. *Sero venientibus ossa.* "The late-comers get the bones."

CHAPTER XX.

286. *Parterres.* Gardens laid out in ornamental beds or plots.

287. *Coign of vantage.* A corner from which an extended view may be obtained.

Cynosure. The Pole Star, the fixed star by which the mariner guides his way. Hence, anything which attracts attention. Compare Milton :—

"The cynosure of neighbouring eyes."

"And thou shalt be our guiding star,
Our Tyrian cynosure."

288. *Curious inspection.* Not a *strange* or *peculiar* inspection, but a *careful* one.

290. *Syllogism.* A term employed in Logic. A syllogism consists of three statements—the first two giving data, the third being a logical inference from the other two. For instance, the following is a syllogism :—

(1.) Major premiss—All men are mortal.
(2.) Minor premiss—I am a man.
Therefore
(3.) Conclusion—I am mortal.

Malvolio. The steward in Shakespeare's *Twelfth Night*, who is made to think that his mistress is in love with him. He says, Act ii. Scene 5, "'Tis but fortune; all is fortune. There is example for't: the lady of the Strachy married the yeoman of the wardrobe."

292. *Champaign.* Usually an expanse of level country; here, the whole extent of the garden.

294. *A phial*, etc. Matches were, of course, unknown; flint and tinder were the ordinary means of obtaining a light. Scott here supposes that the Bohemian produced a flame from chemicals, such as was actually done in the early part of the 19th century.

Caitif. A term of abuse. Rascal and coward.

296. *Gibes and quirks.* Jests and sneers.

298. *The youth prefers veal to beef*—that is, the young one to the old one.

Welkin. The heavens.

300. *Wassail.* Drinking, revelry. A.S., waes hael! Health to you.

CHAPTER XXI.

301. *Great keep.* The strong central tower in a castle.

Quarter. Mercy.

Castle fosse. The moat or ditch surrounding the castle.

302. *The chains.* By which the drawbridge was raised and lowered.

Landsknecht. Soldier.

Sally. A rush out by the besieged. Fr. *saillir.*

305. *Arras.* Tapestry covering the walls.

Oratory. A small private chapel; a room for praying. Lat. *oro*, I pray.

306. *Schelms.* Rascals.

Beam and scale. The beam is the rigid bar which supports the scales of a balance.

307. *Vung frau.* Young lady.

308. *Frampold.* Peevish, discontented.

Fabliau. Fable.

309. *Saus and braus.* Riot and tumult.

312. *Ein wort, ein man.* One word, one man. A man should be true to his word.

CHAPTER XXII.

317. *Schwarz bier.* Black beer.

Plate. Gold and silver vessels.

318. *Frontless dastard.* A coward without any determination.

Malapert. Saucy, impudent.

Stanchion. A bar supporting any weight in a building.

Brach. A slim hunting dog, used for following game, but not strong enough to kill it. De la Marck suggests that the burgomaster had merely tracked the game—that is, the bishop—but that he had been the wolf dog to bring it down.

Mars. The god of war, who is often represented in pictures as accompanied by Venus, the goddess of love and beauty.

320. *Sapperment.* An exclamation of surprise = Really!

321. *Grisly.* Spectre-like. *Satellite.* A follower.

Ban of the Empire. See note on p. 181.

322. *Palmer.* A pilgrim who carried a branch of palm as a sign of his profession.

Imperial Chamber. The council of the princes of the German Empire, presided over by the emperor.

324. *Dirk.* A short dagger.

Carrion. Dead body—used contemptuously.

326. *Kurschner lads.* Skinners or furriers.

327. *Burghers-twentieths.* A tax levied on the burgesses of the town.

328. *Maunder.* To wander in talk from one subject to another.

CHAPTER XXIII.

331. *Belligerent powers.* Those carrying on warfare; engaged in fighting.

A milkmaid, etc. When the canals of the Netherlands are frozen over in winter a good deal of travelling is done on skates.

332. *Paramour.* Lover.

333. *Haft.* Handle.

336. *Bachelor.* Young man; lover.

Boor. Peasant. The word had not originally a contemptuous meaning.

337. *Damsel-erranting.* Wandering about in search of adventure.

Rake-helly. Vagrant; wandering.

339. *A poet of my own land.* Thomas Barbour. The lines are from his poem "The Bruce."

Poortith. Poverty.

Tirade. Speech full of enthusiasm.

Voluptuary Edward. Edward IV. was addicted in the times of peace to the pursuit of sensual pleasures (Lat. *voluptas*), which seriously detracted from the character he had acquired as a soldier.

341. *The most distracted country in Europe.* Through the Middle Ages, Scotland was in a most unsettled condition. The kings governed only those parts near the capital. "Kings of Fife and Lothian," the borderers called them.

344. *Jargon.* Unintelligible talk.

345. *Dorf.* A village. Compare Dusseldorf.

346. *Schwartz-reiters.* Black horsemen.

Lower Circles of Germany. The northern districts of Germany. The southern part was called High Germany.

347. *Knight's pennon.* The pennon was a small flag attached to the lances, the shape varying with the rank of the holder.

Cloven heart. The sign or armorial bearings of *Crèvecœur.*

CHAPTER XXIV.

349. *Causeway.* A paved road. O.F. *chaussie.* From Lat. *calx*, the heel.

Coif. A cap or headdress, usually tight-fitting. Low Lat. *cofia*, a cap.

355. *St. Lambert.* The patron saint of Liege.

356. *Plebeian.* The common people. Lat. *plebs*, the people.

Marches of Flanders. The country bordering on Flanders. Compare the Scotch and Welsh marches.

357. *Court of Cocagne.* The land of Cockaigne (as usually spelt) was an imaginary land of idleness and luxury. London is so called (hence Cockney); the term is also applied to Paris. In an old French poem on the subject, "the houses were made of barley-sugar and cakes, the streets were paved with pastry, and the shops supplied goods for nothing."

Predicated. Stated.

Goading. Driving oxen with a sharp-pointed stick or goad.

359. *Morgaine la Fée.* Daughter of Queen Igrayne, and half-sister to King Arthur. She opened the king's eyes to the intrigues between Lancelot and Guinever.

Amadis and Oriana. The hero and heroine of *Amadis of Gaul*, a romance in Portuguese, by Vasco de Lobeira of Oporto.

Inamorato. Lover.

GENERAL INFORMATION FOR SCHOLARSHIP.

PERHAPS in no other language are contractions so widely employed as in English. It is well, therefore, to pay some attention to the signification of the contractions in common use; so we will endeavour to arrange them in classes for convenience of study.

1. *University Degrees.*—The lowest degree granted by a university is the bachelor's degree. Thus we have B.A., B.Sc., B.Mus. (or Mus. Bac.), B.S., B.M. (or M.B.), LL.B., B.D., B.C.L., denoting the holder of the bachelor's degree in arts, science, music, surgery, medicine, laws, divinity, and civil law respectively. It is important to notice the difference between B.S. (Bachelor of Surgery) and B.Sc. (Bachelor of Science), and also the fact that as music and medicine begin with a common

initial, the contraction for the former is Mus. We must also point out the fact that when the singular of a noun is denoted by an initial or contraction, the plural is indicated by doubling that initial or repeating the last letter of the contraction. This explains the use of LL.B. for Bachelor of Laws, and MSS. for manuscripts. On comparing the inscriptions on coins, we find Britanniarum Regina on the half-crown, which means really Queen of the Britains, the different parts of the British Empire justifying the use of the plural of Britain; but on the smaller coins the contraction for Britanniarum (*with one t*) is spelt Britt. (*with two*) in accordance with the above rule.

The student should notice that in LL.B. there is no stop between the two L's, and the second L may be smaller than the first. The University of St. Andrews grants a special degree to ladies, indicated by the letters L.L.A. (Lady Literate in Arts), and in this contraction, since each L stands for a different word, it must be followed by a point.

In arts and surgery the holder of the higher degree is called a master, but in the other faculties he is called a doctor. The student will now understand the signification of M.A., D.Sc., D.Mus. (or Mus. Doc.), M.S., M.D., LL.D., D.D., and D.C.L.

2. *The Learned Societies.*—The members, fellows, and associates of the following societies are denoted by the letters M., F., or A., with the initials of the names of the society or institution:—

College of Preceptors, a body formed for examining the pupils and granting diplomas to teachers in secondary schools.

Institute of Actuaries.

Institute of Civil Engineers.

King's College, London, an important college in London which grants a diploma of associateship to students.

Royal Academy, a society of artists. The actual members are called Royal Academicians (R.A.), but there are also associates (A.R.A.).

Royal Scottish Academy, a similar society, with headquarters in Edinburgh.

Royal School of Mines, a government college for teaching mining and kindred subjects. It grants an associateship to students (A.R.S.M.).

Society of Arts.

Chemical Society, a society for furthering knowledge of chemistry.

Educational Institute of Scotland.

Royal Astronomical Society.

Royal College of Physicians and Royal College of Surgeons, two bodies with power to grant diplomas for the practice of medicine and surgery to their members, M.R.C.P. and M.R.C.S. respectively, and licenses to other qualified medical men, L.R.C.P. and L.R.C.S. The governing body consists of Fellows, who are the most distinguished physicians and surgeons of the country. There are similar colleges for medicine in Edinburgh, and a College of Surgeons of Ireland.

Geological Society.

Royal Geographical Society.

Royal Horticultural Society.

Royal Institute of British Architects.

Royal Society. Fellowship of this society is one of the most coveted honours of scientific men.

Zoological Society. The gardens of this society in Regent's Park, London, contain one of the finest zoological collections in the world.

Pharmaceutical Society. This grants licenses for the dispensing of prescriptions and the sale of drugs to those who pass the necessary examinations.

Royal College of Veterinary Surgeons.

Royal Institution, a scientific society among whose lecturers were such men as Faraday and Davy.

Royal Academy of Music, and Royal College of Music, two great musical colleges in London.

3. Other well-known societies denoted by initials are:—

Society for Promoting Christian Knowledge.

Society for the Propagation of the Gospel (in foreign parts).

Society for the Prevention of Cruelty to Animals.

United Kingdom Alliance.

Young Men's Christian Association.

Young Women's Christian Association.

4. Titles, including orders of knighthood.

Many of these are so well known—for example, H.R.H.—that we will not stop to quote them.

A.D.C. = Aide-de-camp.

Bart. or Bt. = Baronet. This ranks as the lowest *hereditary* title.

The orders of knighthood are:—

(*a*) Bath. This order includes Knights Grand Cross, Knights Commanders, and Commanders—K.G.C.B., K.C.B., and C.B.

(*b*) Garter. The most ancient British order, instituted by Edward the Third in 1348. There is only one grade, and that limited to about fifty knights—K.G.

(*c*) Indian Empire. Knights Commanders are appointed for conspicuous service to the crown in India—K.C.I.E.

(*d*) Star of India. Conferred for service to the Indian Empire; its members are knights—K.S.I.

(*e*) St. Michael and St. George. Conferred in connection with the colonies and foreign affairs. K.C.M.G. stands for Knight Commander of (the most distinguished order of) St. Michael and St. George.

(*f*) St. Patrick. Instituted by George the Third in 1783.

(*g*) The Thistle. Instituted in 1540, but it fell into disuse, and was revived in 1687.

V.C. = Victoria Cross. A decoration given for conspicuous bravery in presence of the enemy.

D.S.O. = Distinguished Service Order.

R.V.O. = Royal Victorian Order. Conferred for services to the late Queen.

D.L. = Deputy Lieutenant.

J.P. = Justice of the Peace.

K.C. = King's Counsel. The higher class of barristers.

M.P. = Member of Parliament.

Rt. Hon. = Right Honourable. Members of the Privy Council are styled Right Honourable.

Rt. Rev. = Right Reverend. A term applied to bishops.

5. Many contractions are used in business, and their use tends to spread. Thus ships belonging to the first division of Class A are described by insurance agents as A1, a term which is now often applied to other things.

f.o.b. = free on board, and implies that the seller of the goods will deliver them on board a ship, although the carriage from the port must be paid by the purchaser.

I.O.U. = I owe you. A document acknowledging a debt.

£. s. d. = *librae, solidi, denarii*, the names of Roman coins, which, although not of the same value as our pounds, shillings, and pence, supply initials to denote them.

N.B. = *nota bene*, note well, or take particular notice.

Nem. con. = *nemine contradicente*, nobody contradicting. A resolution may be carried at a meeting *unanimously*, which means that the meeting was of one mind in favour of the resolution; but if some of those present were not in favour of the resolution, but did not record their votes against it, the resolution is said to be carried *nem. con.*

Non seq. = *non sequitur*, it does not follow. This is applied to a conclusion incorrectly drawn from the premises. Thus if we attempt to inscribe a square in a triangle by inscribing first a circle in the triangle and then a square in the circle, and argue that because the square has been inscribed in the circle and the circle has been inscribed in the triangle, *therefore* the square has been inscribed in the triangle, we have an example of *non seq.*; because a square is said to be inscribed in a triangle when each of its angular points is upon the perimeter of the triangle, and this will not be the case in this instance.

q.s. or *quant. suff.* = *quantum sufficit*, as much as is sufficient. The term is used in doctors' prescriptions.

aq. quant. suff. = a sufficient quantity of water.

q.v. = *quod vide*, which see.

i.e. = *id est*, that is.

e.g. = *exempli gratia*, for the sake of example. When examples are quoted they should never be followed by *etc.*, because *etc.* = *et cetera* = and the rest; but the "rest" are not given as examples, and should not therefore follow the sign *e.g.*

ut sup. = *ut supra*, as above.

v. = *versus*, against.

viz. = *videlicet*, namely.

sine die, without a day (being fixed).

6. The following are some miscellaneous contractions in common use:—

S.P.Q.R., *Senatus Populus-que Romanus*, the Senate and People of Rome.

R.I.P., *requiescat in pace*, may he rest in peace.

pro tem. = *pro tempore*, for the time being.

P. and O., Peninsular and Oriental Steamship Company.

M.C.C., Marylebone Cricket Club. A club whose rules are generally followed in cricket.

D.V., *Deo volente*, God being willing.

OUR CERTIFICATE COURSE FOR 1902.

BY GEORGE COLLAR, B.A., B.SC.,
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TEST QUESTIONS ON LAST MONTH'S WORK.

THEORY OF TEACHING.

1. WHAT place do geography and history hold in Locke's scheme of a liberal education; and how does he support their claims?
(Certificate Examination, 1892.)

2. Character has been defined as a "completely fashioned will." What does this mean? Say by what sort of discipline and exercise the will may be trained in a school.
(Certificate Examination, 1893.)

ARITHMETIC.

1. Which is the better investment—a 4 per cent. stock at 127, or a 2 per cent. stock at 70? What sum must be invested in the former to derive an income of £294, 4s. 8d.?

2. If the true discount on a sum due 4½ years hence, at 4½ per cent. per annum, simple interest, is £162, find the sum. Find also the exact compound interest on the true discount (£162) for two years at 3 per cent.

ENGLISH LITERATURE.

1. Give an outline sketch of the subject-matter of the first book of *Paradise Lost*.

2. What are the essential characteristics of an epic poem? Show that these are all possessed by *Paradise Lost*.

GEOMETRY.

1. If AB and CD are equal chords in the circle ABCD, show that AC is equal to BD.

2. If two circles touch one another, either internally or externally, prove that any straight line drawn through the point of contact cuts off similar segments.

FRENCH.

1. Give the rules which Latin words have followed in giving rise to French words.

2. Translate into French:—

Is there anything more beautiful than a great forest? Sad in winter, as though dead under its mantle of snow, it awakes in spring greener than ever; it becomes all at once gay, smiling, full of the songs of birds, scented with a thousand flowers. Summer comes; the forest is shady, and impenetrable to the burning rays of the sun. When autumn arrives it puts on a fine mantle of gold.

3. Translate into English:—

"Ma fille, il ne faut point rougir d'un si beau feu,
Ni chercher les moyens d'en faire un désaveu;
Une louable honte en vaine t'en sollicite;
Ta gloire est dégagée, et ton devoir est quitte;
Ton père est satisfait, et c'était le venger
Que mettre tant de fois ton Rodrigue en danger.
Tu vois comme le ciel autrement en dispose;
Ayant tant fait pour lui, fais pour toi quelque chose,
Et ne sois point rebelle à mon commandement,
Qui te donne un époux aimé si chèrement."
CORNEILLE, *Le Cid*.

POLITICAL ECONOMY.

1. Because English imports largely exceed in value English exports, is it true that England is becoming impoverished by her foreign trade? Give an explanation of this excess in the value of our imports.

2. What is meant by "reciprocity"? In the case of trade between a country adopting protection and one adopting free trade, which country as a whole is the loser?

NOTES AND SYLLABUS FOR APRIL.

COMPOSITION.

Revise the figures of speech, and note down all figures you meet with in reading Milton.

Write essays on the following subjects:—

1. Compulsory Education.
2. The Different Kinds and Purposes of Poetry.
3. "Manners are not idle, but the fruit
Of loyal nature and of noble mind."
TENNYSON.
4. "They never fail who die
In a great cause." BYRON.

THEORY OF TEACHING.

1. Study the first part of chap. xii. of the text-book of *School Management*. Observe the various considerations which apply to mathematical teaching in general, and to the teaching of arithmetic in particular; hence deduce the different treatment that arithmetic should receive in schools where it forms the whole mathematical teaching the pupils have, and in schools where other mathematical studies—for example, Euclid and algebra—are studied.

Since arithmetic is the science of number, it is of prime importance that the pupils should have a clear conception of number given them to start with, and that all the teaching should rest upon the real nature of number. Much of the faulty teaching of arithmetic is due to neglect of this fundamental rule.

In the section entitled Junior Arithmetic, the most important points to study are the advantages of treating subtraction by the method of "complementary addition," the method of obtaining the true remainder when dividing by factors, and the Italian or Continental method of long division.

2. Study Dexter and Garlick, chap. xxii., on "Habit." If we take a good-sized sheet of paper, it is as easy (or as difficult) to fold it in one part as in another; but after it has been once folded, it folds more easily along the crease first made. The reason of this is that the forces which offered a resistance to folding have been to a certain extent broken down by the first act of folding. In the same way, a piece of machinery works more smoothly after a little use, because friction has been reduced by the wearing away of the roughness on the surfaces which at first impeded motion. The comparison of the elaborate nervous system of a man and his sets of muscles to a mere piece of paper which may be folded is by no means a fanciful one, but one that has a basis of physical fact. The muscles employed to perform a particular act are set in motion by a nervous discharge which has its origin in the central nervous system; and if the particular act has never been performed before, there is apparently no reason why the discharge should travel by one set of nerves rather than by another, as every passage offers the same amount of resistance. But if the discharge is directed carefully down one channel, the next occasion finds that channel prepared for the passage of a similar discharge, which in its turn still further smooths the way for its successors.

The importance of habits is due to the fact that they save us an immense amount of mental or nervous labour. In the first instance considerable effort is needed to make the discharge travel down the proper path, and the very act of deliberating implies that there is a possibility of producing a wrong result. A beginner on the bicycle sees a brick lying in the road, and he thinks that if he moves the handles of his machine in a particular manner he will cause the front wheel to turn, and so make the machine pass by the side of the brick. The reasoning is correct; but, alas, before he can induce the nervous discharge to cause the necessary muscular contractions, it takes a wrong course or a belated one, and the cyclist finds himself on top of the very obstacle he desired to avoid. After frequently turning his bicycle on the road, he no longer thinks what action is necessary to avoid an obstacle; the very sight of a brick in the path is sufficient to cause the nervous discharge, which seems to take its way naturally down the path prepared by previous discharges. It is not difficult to give abundant instances of this kind of thing. Take, for example, the ease with which a pianist brings down his fingers, each on the proper key, merely as the result of the nervous stimulus produced by certain musical signs. Habit enables him to avoid pausing to consider which finger he shall use and where he shall put it.

In the cultivation of habits, the teacher has to distinguish between good and bad habits—that is, between those that make for a pupil's advantage and those that will tell against him later in life. We need not give lists. Professor Bain attaches considerable importance to the prominence given to the commencement of a new habit or the breaking off of an old one. The determination to act should be carried out with force and decision. He also points out the importance of never allowing an exception to occur until the habit is thoroughly rooted.

This is more important in moral habits than in physical or intellectual ones; and in dealing with these he goes on to say: "The peculiarity of the moral habits, contradistinguishing them from the intellectual acquisitions, is the presence of two hostile

powers, one to be gradually raised to an ascendency over the other. In such a situation it is necessary, above all things, never to lose a battle. Every gain on the wrong side undoes the effect of many conquests on the right." It is also important to bear in mind that while the acquisition of a practical good habit is a thing to be desired, the *habit of merely resolving to do well* is decidedly a bad thing. Good intentions have been compared to paving stones, which simply harden the downward path. A good resolve must be put into effect at once, and the act—not the resolve—be repeated until it becomes a habit. Again, pupils must be taught to look for opportunities of acting, and seize them, in no matter what commonplace condition, and not dreamily wait for a grand opportunity to come to them. Unless they are prepared by the habit of acting in small matters, they will certainly be unable to act in a great one should it present itself.

3. Study Locke's *Thoughts*, pars. 171 to 195.

Arithmetic.

Study the chapters dealing with the mensuration of plane rectangular surfaces, and with square root. The practical work involved presents very little difficulty, but an important point in theory arises out of a form in which the rule for finding the area of a rectangle is frequently given. We frequently say that to find the area we must "multiply the length by the breadth." Now, if the length of a rectangle is 4 feet and the breadth 3 feet, the rule tells us to multiply 4 feet by 3 feet; but any one who pretends to be able to multiply by a concrete quantity simply reveals his ignorance of the nature of multiplication. Since the latter is the process of finding the sum of a quantity taken a certain *number of times*, it follows that we can multiply *only by abstract numbers*. The correct way of stating the rule, then, would be: "The *number* of square units in the area is equal to the product of the *numbers* of lineal units in the length and breadth;" and although the common rule is short and handy, it should never be used unless it is taken to have this meaning.

English Literature.

Finish the first book of *Paradise Lost*.

At the call of Satan the fallen angels arise in number like the locusts that came over Egypt at the call of Moses. Here the poet makes a digression, and invokes the Muse to tell their names; and we have a list of all the evil gods of antiquity. "All these and more came flocking," and their martial array is described. Satan addressed them and exhorted them—

> "To work in close design, by fraud or guile,
> What force effected not."

And the book closes with the summons to the great council of Pandemonium.

404. *Vale of Hinnom*, the valley into which Josiah cast the remains of the idolatrous material after he had burned it. (See 2 Kings xxiii., and also line 418.)

412. *Peor*—that is, Baal-peor. (See Num. xxxi.)

423. *Feminine*. This is a poetic licence: we should say female, as it is applied to sex and not to gender.

444. *Uxorious king* (Lat. *uxor*, a wife)—that is, Solomon. (See 1 Kings xi. 3, 5.) Under the influence of his wives he "went after Ashtoreth, the goddess of the Zidonians."

506. *The prime*, the first or chief. It should be noticed that "though far renowned the Ionian gods," yet Milton places them as inferior in rank to the idols of the Old Testament nations.

546. *Orient colours*—that is, Eastern colours. This may refer to the colours of the sky at sunrise, but more probably to the iridescent colours of pearls, the most beautiful of which came from the East, and were spoken of as "orient pearls."

550. *Phalanx*, the battle array of the Greeks, who depended for success upon the shock of their onslaught, and arranged their soldiers in compact masses. At first these were five ranks deep, but the number was afterwards increased.

573. *Since created man*—that is, since man was created, or since the creation of man. This is one of the Latin constructions of which Milton was so fond. The past participle was frequently used with a noun in Latin in this way; thus the dates of years were reckoned by the Romans from the year of the founding of Rome, and the expression used was "*anno urbis conditæ*"—literally, in the year of the founded city.

575. *Small infantry*, the Pygmies, a nation of dwarfs warred on by cranes every spring-time. The idea, suggested no doubt by frogs, is found in Homer and other writers. The adventures of Hercules among them suggested Swift's description of Gulliver among the Lilliputians.

580. *Uther's son*—that is, King Arthur, who was king of Britain and of Brittany, called Armorica.

584. *Damasco, Marocco, Trebisond*, Damascus, Morocco, and Trebizond, places famous as the scenes of battles during the Crusades.

585. *Biserta*, on the north coast of Africa. The Saracens crossed from the north of Africa, conquered Spain, and defeated Charlemagne at Fontarabia.

646. *To work in close design*, to accomplish secretly.

670. *Grisly*, horrible.

> "On yonder cliffs, a grisly band,
> I see them sit, they linger yet,
> Avengers of their native land."
>
> Gray's *Bard*.

The word is often confused with *grizzly*, which means grayish—for example, the *grizzly* bear.

690. *Admire*. Here used in its original sense, "to wonder."

713–16. Note the architectural terms employed:—*Pilasters*, square pillars or segments of pillars attached to walls. *Doric pillars*, the simplest of the Greek pillars; the capital consists of rings. *Architrave* (a hybrid word—*archi*, Gr., chief, and *trave*, from Lat. *trabs*, a beam), the beam which passes from pillar to pillar and supports the *frieze*, which is surmounted by a *cornice*, which is a sort of projecting moulding. The three parts—architrave, frieze, and cornice—make up the *entablature*, as we call the whole of the work which rests upon the pillars.

739. *Ausonian land*, Italy.

740. *Mulciber*, Vulcan, the god of the forge.

740–5. Note the beauty of these lines.

764. *Wont ride*, were accustomed to ride.

785. *Arbitress*. As the moon (Luna) is always feminine by personification, the feminine is used, and not *arbiter*. An arbiter is generally a judge or umpire, but sometimes, as in this case, a "witness."

795. *Conclave*, a meeting carried on with *locked* doors. (Lat. *clavis*, a key.)

Geometry.

Women.—Revise the propositions generally, work exercises, and send up difficulties.

Men.—Revise the fourth book. The only proposition that gives any trouble is the tenth; but after a careful examination of it, the student is much more impressed with the ingeniousness of it than with its difficulty. The best way to master the proposition is to suppose such a triangle constructed, and examine its properties. Let ABC be an isosceles triangle, having each of the angles ABC and ACB double of BAC; bisect the angle ABC by the straight line BD, meeting AC in D. Then we discover the following relations:—

1. Because ABD = ½ ABC, it is equal to DAB.

Therefore AD = DB (I. 6).

Therefore also the two, DAB and DBA, are double one of them, DAB, and these two are equal to CDB (I. 32), and therefore BDC = BCD, which is also double of DAB. ∴ DB = CB (I. 6).

Thus the three lines CB, BD, *and* DA *are equal to one another.*

2. Again, BC is a tangent to the circle circumscribed to the triangle ADB, because CBD = DAB (converse of III. 32); and this being so, it follows that BC^2 = rect. AC . CD.

3. Since AC = AB, the circle drawn from centre A with radius AC will pass through B, and the line BC is therefore *placed* in this circle.

If the student familiarises himself with these properties of the triangle, the construction is simple.

Trigonometry.

Finish the solution of triangles, and practise examples.

Political Economy.

Study the question of taxation—Mrs. Fawcett, Section IV., chap. 3. The chapter is based upon the four principles of taxation laid down by Adam Smith (*Wealth of Nations*, Book V., chap. ii.), a summary of which is given in the chapter. The first principle is the most difficult of application, from the difficulty of judging the ability of people to pay the tax. No test can possibly be applied which can arrange people in a list in order of their ability to pay taxes. Income received is perhaps the best test, but it leaves out of account the calls on a person's purse by relatives, etc., dependent upon him.

French.

Study the rules for the agreement of the past participle. The present participle never varies; if a word spelt like a present participle is made to agree, it ceases to be a participle, and must be called a verb.

OUR CERTIFICATE COURSE FOR 1903.

Test Questions on Last Month's Work.

1. Say what is meant by a good style of questioning, and what are the tests by which you would distinguish a good from a bad question. Discuss the value of catechisms.
2. Give a summary of the first Act of *Richard the Third*.
3. What permanent effects were produced by the Danish invasions?
4. Name the chief mineral products of the British Isles, and say in which localities each is found.

SYLLABUS AND NOTES FOR APRIL.

Theory of Teaching.

Study chap. vi. of the text-book. It is particularly important to bear in mind the fact that lessons on different subjects require very different treatment in the notes. The amount to be entered as "Matter" in a lesson on history should be much greater in proportion to the "Method or Treatment" than in the case of an object lesson or an elementary science lesson.

English History.

Since the Saxon element predominates in our population, it is especially important to consider what sort of men our Saxon forefathers were, and how their manners and institutions have affected our own. While still in their Continental quarters, they are described by Tacitus and other writers as being noted for their love of freedom and respect for the rights of men, and for the honour and respect shown to the women, and for the virtuous conduct of the latter. They did not live in walled cities, nor lead altogether solitary lives, but dwelt in villages. The Danes were closely allied by origin to the Saxons, and the political institutions of the two were very much alike. Both chose their kings from certain families which were believed to be descended from Odin. Without the "Ting" or "Thing"—that is, the assembly of free warriors—the king could not make a law, raise an army, or levy a tax. Besides these national assemblies, there were meetings of the freemen of each district for matters of local government. Our accounts of the Danes are derived mainly from the writings of monkish chroniclers, the people on whom fell the chief horrors of the invasion; but we must remember that the Danes showed evidence not only of great valour by land and sea—especially the latter—but they were chivalrous to their women, fond of freedom and of poetry, and patrons of manufactures and commerce.

In early Saxon times the free people consisted of nobles, called eorls, and commoners, called ceorls. In later times the word "eorl," through the influence of the Danish word "jarl," came to denote the governor of a province. Hence, in order to avoid confusion, some writers invariably speak of the Saxon nobles as "thanes." But it was not enough to be of noble birth—a man had to be the owner of a certain amount of land in order to be a thane; and with the title were associated certain important social and political privileges.

The ceorls formed by far the most numerous class, and corresponded to the yeomen and better class of peasants of later times. Most of them lived in the country, and hence it is probable that Roman influence as well as Roman names survived largely in the towns. The ceorls were obliged to be under the protection of some lord, and generally held their land from him in return for certain services. Ceorls of this class could not leave the land without the lord's consent; and if the land changed owners, the ceorls passed under the protection of the new owner of the land. Yet the ceorls differed in many essential points from the *serfs* or *villeins* of feudal times. A ceorl (*a*) had a right to bear arms; (*b*) could acquire and hold property in his own right; and (*c*) if he were injured or killed, the fine or *were-gild* was paid to him or his family, and not to the lord; (*d*) he had a legal standing in a court of justice as a witness, or a plaintiff, or a defendant—that is, he was *law-worthy*, or, as we now say, a *lawful man*; (*e*) he had important political rights as a member of a *tithing*.

With regard to local government, it is quite wrong to say that the country was divided up into shires, and these into hundreds, and the hundreds into tithings. The organisation proceeded in the other direction: groups of freemen (generally ten), acting for mutual security, formed the tithing; a number of tithings grouped together made up the hundred; then neighbouring hundreds coalesced and formed the shire; a number of shires united and chose a king, thus forming a kingdom, of the union of several of which (nominally seven) England consisted. A township was the domain of a thane or other powerful Saxon, and was peopled by his slaves and by ceorls, who were under his protection. Each township had an elected officer, the *gerefa* or reeve, who, together with four elected townsmen, represented the township in the judicial courts of the hundred and the shire. The thanes of the district were bound to attend the council of the hundred, or Hundredmôt; and twelve thanes were elected by each hundredmôt to represent the hundred at the Shiremôt. The Witenagemôt was the highest assembly of the kingdom, but was not, as is commonly supposed, a representative assembly; it was, in fact, a highly aristocratic body, although the reeve and elected townsmen could attend to obtain justice when they had failed to obtain it from the inferior courts.

The thanes had many privileges. A thane's oath was considered equal to those of six ceorls; hence it required at least seven of the latter as witnesses to gainsay what had been asserted by a thane, and the fine or *were* for killing a thane was six times as great as that for a ceorl. As lords of the townships and members of the Shiremôt and Witan, the thanes possessed a preponderating share of political power. Yet this class did not form an exclusive caste, for it was open to any ceorl to acquire the qualifying amount of land and become a thane, and the rank was also open to the successful merchant. Local self-government continued to flourish in the towns, where every freeman who paid his *scot* (that is, his share of local taxes) and bore his *lot* (that is, his share of personal services) was a burgess, with full right to take his share in the municipal government.

The king was chief magistrate and commander-in-chief, but his powers were strictly limited. He could act in important matters, such as making laws and imposing taxes, only in conjunction with the Witan, although Danegeld was sometimes arbitrarily demanded. The king was not regarded as the paramount proprietor of all land; and it was only with the consent of the Witan that he could make a grant of public land, or *folcland*, as all land was called which was not the absolute private property of an individual. Land was assigned to a private individual by a charter or *bôc;* hence private land was called *bôc-land*.

It came to be a recognised principle that the king must be a member of the house of Cerdic, and was generally the next male heir, although tender age or personal disqualifications sometimes barred the succession. It was essential that the king should be chosen by the Witan, and acclaimed by the people at the coronation. The oath taken by Ethelred at Kingston is still preserved. As the king appointed the chief officers of state—and not only were his chief officers members of the Witan, but he had the right to appoint the time and place of meeting of the Witan—he must have had great influence over the deliberations of that assembly.

The lowest class of all were the *theowes* or *thralls*, who were in a condition of absolute slavery. Many of them were probably descended from the conquered Britons, but others were of Saxon race, who had got into bondage through not being able to pay fines imposed for crimes committed, or who had sold themselves into slavery in times of famine. In the will of a Saxon lady, who directed that her slaves of this class should be set free, she speaks of them as "the men who bent their heads in the evil days for food." A father had the legal right to sell his child in time of necessity; but if the child was over seven, his own consent was necessary.

A man charged with a crime was tried before a number of the people, and not by an officer of the king. This arrangement contained the germ of our trial by jury, but must not be supposed to be identical with it. A man might be tried before the Shiremôt on the application of the chief men of his hundred or township, and here we have the origin of our grand jury system. [The grand jury is a jury that goes through the evidence to see whether there is sufficient of it to justify a trial being held.] Testimony of good character was allowed great weight in a man's favour. A man could swear to his own innocence, and get a number of people to swear to their belief in it; and if this weight of testimony convinced the court, the accused was said to be acquitted by *compurgation*. Trial by *ordeal* was also allowed; but neither of these methods would avail a man of bad character, or one against whom the evidence was strong. Summary justice was meted out in those cases.

We must close these notes on the Anglo-Saxon period with a strong recommendation to study up the relation of Anglo-Saxon language to modern English, and to read the account of the literature of the period in a manual of literature.

English Language and Literature.

Prepare Nesfield, chap. v.

Read carefully through the second Act of *Richard the Third*. Note down and commit to memory all passages illustrative of character, history, or grammar.

Geography.

Political geography of England.

LONDON MATRICULATION.

JUNE 1902.

"HELPS" FOR THE LATIN PAPERS.

BY C. J. PHILLIPS, M.A.,
Stockwell Pupil Teachers' Centre.

ANSWERS TO TEST PAPER IN GRAMMAR.

1. (*a*)

	Sing.	*Plur.*	*Sing.*	*Plur.*
N.	Deus.	(Dii) Di.	Vis.	Vires.
V.	Deus.	(Dii) Di.	——	——
Ac.	Deum.	Deos.	Vim.	Vires.
G.	Dei.	Deorum (Deum).	——	Virium.
D.	Deo.	Dis (Diis) (Deis).	——	Viribus.
Ab.	Deo.	Dis (Diis) (Deis).	Vi.	Viribus.

	Sing.	*Plur.*	*Sing.*	*Plur.*
N.	Iocus.	Ioci (*or* ioca).	Caelum.	——
V.	(Ioce).	Ioci (*or* ioca).	Caelum.	——
Ac.	Iocum.	Iocos (*or* ioca).	Caelum.	Caelos.
G.	Ioci.	Iocorum.	Caeli.	——
D.	Ioco.	Iocis.	Caelo.	——
Ab.	Ioco.	Iocis.	Caelo.	——

(*b*) *N. V.* Jupiter omnipotens.
Ac. Jovem omnipotentem.
G. Jovis omnipotentis.
D. Jovi omnipotenti.
Ab. Jove omnipotenti.

Sing.

N. Ferox elephas (elephans) elephantus.
V. Ferox (elephas) elephante.
Ac. Ferocem elephanta, (-em), (-um).
G. Ferocis elephanti.
D. Feroci elephanto.
Ab. Feroci elephanto (-e).

Plur.

N. Feroces elephanti (-es).
V. Feroces elephanti (-es).
Ac. Feroces elephantos (-as).
G. Ferocum elephantorum.
D. Ferocibus elephantis (-ibus).
Ab. Ferocibus elephantis (-ibus).

2. *Prae*, in classical Latin, is a preposition taking the abl. = "before;" in Plautus and Terence also used as an adverb = "formerly."

Ante, (*a*) preposition taking acc. = "before." (*b*) Adverb = "before."

Sub, preposition taking (*a*) acc., (*b*) abl. = "under"—for example, (*a*) *Curramus sub arborem*, "let us run under the tree" (not being under it now). (*b*) *Ibam sub arboribus*, "I was walking under the trees" (being under the trees all the while).

Palam, adverb = "openly;" preposition (abl.) in later Latin = "in presence of."

Penes, preposition (taking acc.) = "in the house of," "in the power of."

3. *Oriar* ("I rise"), oriri, ortus sum.
Ordior ("I begin"), ordiri, orsus sum.
Paro ("I prepare, get"), parare, paravi, paratum.
Pareo ("I obey"), parēre, parui.
Pario ("I bring forth"), parĕre, peperi, partum.
Vendo ("I sell"), vendĕre, vendidi, venditum.
Venio ("I come"), venire, veni, ventum.
Veneo ("I am sold"), venire, venivi, venitum.

4. *Bini, binae, bina* = two each.
Centeni, centenae, centena = a hundred each.
The chief uses of the distributives in prose are:—
(1.) In the distributive sense—for example, *Dedit fratribus centenos libros*, "He gave his brothers a hundred books each."
(2.) In expressing factors—for example, *bis bina*, "twice two."
(3.) With nouns that have no singular—for example, *bina castra*, "two camps."

5. The ordinary Latin verb has three participles only:—
(1.) Present participle active, *amans, monens*, etc., "loving," "advising," etc.
(2.) Future participle active, *amaturus, moniturus*, etc., "about to love," "advise," etc.
(3.) Past participle passive, *amatus, monitus*, etc., "having been loved," "advised," etc.

Deponent verbs have, as a rule, (1) and (2), which really belong to the active forms, as well as (3) which is passive—for example, *conor* ("I try") has *conans* ("trying"). *conaturus* ("about to try"), and *conatus* ("having tried"). Some intransitive verbs have past participles used in the neuter only with an impersonal sense—for example, *ventum est, pugnatum est.*

ANSWERS TO TEST SENTENCES SET LAST MONTH.

1. Neque profecturus neque proficiscens neque profectus voluit quidquam dicere.
2. Nisi Caesar se, priusquam advenissent reliquae naves, soluturum esse negavisset, iam de Britannis actum fuisset (*or* esset).
3. Si tu arbitraris omnibus voluptatibus a te fruendum esse, cur non credis ea quae velim legenda esse mihi?
4. Num tu, illa epistola lecta, aedilem te factum iri speras? (*or* fore ut aedilis fias?)
5. Non ii sunt consules quibus unquam persuadeatur ut ex Roma excedant.
6. Num idem sunt illi quos heri vidimus?
7. Utinam ego, quis canem interfecerit, nescirem.
8. Pransi, dum nox advenisset, colloquebantur.

TEST SENTENCES FOR THIS MONTH.

1. Do you not think that we should have captured the city if Antonius had not come to the rescue of the citizens?
2. Gaius said he never could make out whether his house was considered an ornament or an eyesore to the city of Fregellae.
3. As soon as we heard of the enemy's arrival at Corinth, we sent fifty men to warn Galba not to enter the harbour until the Roman cavalry had returned.
4. If you were like your father, you would not hesitate to do what your mother tells you.
5. Don't be surprised if you hear that Marcus has asked my daughter to marry him.

ANSWERS TO TESTS ON CICERO SET LAST MONTH.

Chapter xvii.

1. (*a*) "And in order that you may understand that nothing seems to him so princely as the pursuit of agriculture, Socrates in that book talks with Critobulus, (and says) that Cyrus the younger, king of the Persians, (a man) conspicuous by his abilities and the glory of his rule, when Lysander the Lacedaemonian, a man of the greatest courage, had come to him at Sardis, and had brought him presents from the allies, was gracious and courteous towards Lysander in other ways, and especially showed him an enclosed field carefully cultivated."

(*b*) "As to Marcus Valerius Corvus, we have heard that he prolonged (the pursuit of agriculture) right up to his hundredth year, since he lived in the fields when the prime of life had been passed, and used to cultivate them; and between his first and his sixth consulship there intervened six and forty years. So for him the period of public offices was as great a space as our ancestors chose to consider as reaching up to the beginning of old age."

2. *Dimensa*, nom. plur. neut. past partic. (used in passive sense); from deponent verb *dimetior, -iri, -mensus* (agreeing with *illa*, "those things").

Praeditum, acc. sing. masc. (agreeing with *Lepidum*); from *praeditus, -a, -um*, really past partic. of a verb compounded of *prae* and *do*.

Pluris, genitive of price or value; from *plus, pluris*.

3. (*a*) Lysander dixit recte beatum nominatum esse Cyrum, quoniam virtuti eius fortuna esset conjuncta.

(*b*) Senectus si in honore esset (*or* sit), pluris esset (*or* sit) quam omnes iuventutis voluptates.

Chapter xviii.

1. (*a*) "For these things, which seem trifling and commonplace, are in themselves honourable—to be saluted, to be sought after, to have room made for you, to be greeted by people rising from their seats, to be escorted down (to the Forum), to be escorted back, to be consulted—things which both with us and in other states are observed most carefully in proportion as each state is well conducted."

(*b*) "And those who have made an honourable use of these things seem to me to have completed the drama of life, and not to have sunk down in the last act like unpractised actors."

(*c*) "The fact is so; for just as it is not every wine, so it is not every nature that grows sour by old age. Seriousness in old age I approve of, but that too, like other things, in moderation; sourness (I approve of) in no circumstances; as to an old man's avarice, I do not understand what it wants for itself. For can anything be more ridiculous than to seek for the more provisions the less journey remains?"

2. (a) Quae recta sint sciunt Athenienses, sed ea facere nolunt.
(b) Quo plus haberemus pecuniae, eo minus voluptatis nos habituros esse affirmabant, sed nunquam ego iis, talia dicentibus, credebam.

Chapter xix.

1. (a) "For neither need the actor go right through the drama, in order to give pleasure, so long as he be approved of in whatever act he has appeared; nor need wise men come as far as the fall of the curtain, for a short period of life is long enough to live well and honourably."

(b) "Therefore young people seem to me to die just as when the power of a flame is overwhelmed by a flood of water; old men, on the other hand, just as when of its own accord, with no violence applied, an exhausted fire goes out, and just as fruits, if they are unripe, are plucked with difficulty from trees, (but) if they are ripened and mellowed fall down: so it is violence that takes away life from the young, maturity (that takes away life) from the old, (maturity) which is indeed (a state) so pleasing to me that the nearer I approach to death I seem, as it were, to be sighting land, and at last, after long voyaging, to be about to come into harbour."

2. *Aliquo*, indef. adverb of place = "anywhither."

Viveretur, third sing. imperf. subj. pass.; from *vivo, -ĕre, vixi, victum*. The passive of intransitive verbs is sometimes used in Latin impersonally.

Plaudite, second plur. imper. act.; from *plaudo, -ĕre, -si, -sum*. The word was said by an actor at the end of a play, and hence the *plaudite* came to mean the conclusion of the drama.

Partorum, gen. plur. neut. (agreeing with *bonorum*, neut. of *bonus*, used as a substantive), past partic. pass.; from *pario, -ĕre, peperi, partum*.

3. Non ego credo quemquam, quamvis sit adolescens, tam stultum esse, cui sit exploratum se ad vesperum esse victurum.

Chapter xx.

1. (a) "But the best end of life is when, the mind (being) sound and the senses reliable, that same Nature herself takes to pieces her own work which she put together. Just as (with) a ship, (or) as (with) a building, the same person who put (it) together breaks it up most easily, so (with) a human being that same Nature which welded him into one takes him to pieces in the best way. Further, every recent fastening together is torn apart with difficulty, a long-worn one with ease."

(b) "There are definite interests of boyhood: do, then, youths miss them? There are interests of early manhood: does that settled period of life which is called middle (age) want these? There are interests of this last-mentioned period: not even those are called for in old age. There are certain last interests of old age: therefore, just as the interests of the earlier stages of life fade away, so do also those of old age; and when this has taken place, satiety of life brings on the seasonable moment of death."

2. *Faxit*, third sing.; from *faxim*, an old form of the pres. subj. of *facio*. Cicero says, "*Di faxint!*"

Consequatur is in the subj. mood, because it expresses an idea of cause. The whole sentence means, "He does not consider death to be a mournful thing, considering that immortality follows it."

Obstruere, pres. infin. act.; from *obstruo, -ĕre, -struxi, -structum*. The verb means to block up against, and it takes two objects, an accusative (here *iter*) of the thing blocked up, and a dative (here *Poenis*) of the person against whom the blocking up is directed.

3. Noli oblivisci moriendum esse tibi, atque utrum hoc ipso die necne incertum esse.

TESTS FOR THIS MONTH.

Chapter xxi.

1. Translate:—
   (a) Nam dum sumus inclusi.....contrarium.
   (b) Cumque semper agitetur.....posse interire.
2. Parse:—*modo* in § 77, and *delibatos* in § 78.

Chapter xxii.

1. Translate:—Atqui dormientium.....servabitis.
2. Put into Latin:—
   Cyrus used to say that he could not be persuaded that the soul would ever die altogether.

Chapter xxiii.

1. Translate:—
   (a) Anne censes.....terminaturus.
   (b) Equidem efferor.....recoxerit.
   (c) Senectus autem.....satietate.
2. Parse:—*cuiusque* in § 82, *quid* in § 83, and *calce* in § 83.
3. Put into Latin:—
   Cato believed that when he was dead he would see not only those whom he had known when alive, but also those of whom he had read and written.

NOTES AND JOTTINGS.

MR. YOXALL has a novel in the press. *The Girl from St. Agneta's* will shortly be published by Messrs. Ralph, Holland, and Co.

As a story of life in a training college, in a London Board school, and a village school, the book will be specially attractive to teachers, and is a "novel with a purpose" in so far as it displays the need for protecting schoolmistresses against unjust dismissal. Yet the story is so original in plot and brilliant and humorous in style as to command the interest of the general reader. The author's literary powers and knowledge of the school-world are well known, and the preparation of this story for publication has been a labour of love.

We have received from the Teachers' Guild a programme of the Holiday Courses for the coming summer which have been arranged by that body. The course at Tours will consist of elementary and advanced sections, the former dealing with "L'Esprit Français," illustrated by readings and discussions based upon the works of Théophile Gautier; the latter will deal with various topics connected with French literature. At Honfleur there will be three courses, the elementary dealing with "L'Académie Française," the intermediate with "Le Théâtre en France," and the advanced with "Les Poètes Lyriques Français."

For those who wish to work at Spanish, there will be a course at Santander. The elementary section will apparently work mainly at language and grammar, while the advanced will take Spanish literature in general. Those of our readers who would like to follow one of these courses can obtain particulars as to cost, text-books, and lecturers on application to the Secretary, Teachers' Guild, 74 Gower Street, London, W.C.

Courses have also been arranged by the "Alliance Française" at Caen, where the student can take up phonetics, conversation, reading, and literature. Lectures are given in the morning and evening, and the afternoon is reserved for sight-seeing and excursions. Particulars of these courses may be obtained from Mr. W. Robins, 9 Northbrook Road, Lee, London, S.E.

Mr. S. Ernest Palmer of Reading has founded a scholarship at the Royal College of Music. It will provide free musical education at the college, and a maintenance grant of fifty guineas per annum, and is open to natives of and residents in the county of Berkshire.

An appeal has been issued by the governing body of the City of London College to provide funds to establish and carry on "a complete system of instruction for those engaged, or about to engage, in the various branches of commerce." It is estimated that £25,000 will be required to construct and equip the building, and about £2,000 a year to carry on the work. The trustees of the Mitchell City of London Charity have offered to provide £15,000, provided the rest is subscribed; and it is hoped that the greater part of the sum for carrying on the work will be provided by the Technical Education Board of the London County Council and by the City Charities.

The new Millbank Board School, opened by Lord Reay, is the second London Board school which has been erected on the site of a prison; the Hugh Myddelton School, which was erected on the site of Clerkenwell House of Correction, being the first. The foundations of Clerkenwell prison were so strongly laid that they were used as the foundations of the school, under which some of the old prison cells still exist.

Whether the following story from *The Youth's Companion* is true or not, it has a big lump of educational philosophy in it:—

A little girl from a crowded tenement house was delightedly telling a friend in the college settlement about her new teacher.

"She's just a perfect lady, that's what she is," said the child.

"Huh! How do you know she's a perfect lady?" questioned her friend. "You've known her only two days."

"It's easy enough telling," was the indignant answer. "I know she's a perfect lady because she makes me feel polite all the time."

OUR QUERY COLUMN.

RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the name and address of the correspondent, and the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

A.C.P.—The most reliable single volume is Sir C. Wyville-Thomson's *Depths of the Sea* (Macmillan), 31s. 6d.; but for more recent matter it would be advisable to consult *Nature* (various volumes), *The Scottish Geographical Magazine*, and the various publications of the Royal Societies of London and Edinburgh, the Royal Geographical Society, and the Fishery Board of Scotland, and the reports of the voyage of the *Challenger*. The best Star Atlases are those of Klein, National Society, and Keith Johnston.

For Nautical Astronomy, use J. H. Colvin's work, published by Spon and Co.

For Fluted Spectra, see Lockyer's *Astronomy* (Macmillan).

We regret that we cannot go over your answers. To do so thoroughly would mean many hours' work, and would be a very expensive matter.

Silex.—One of the best books on heuristic lines is Perkins and Lean's *Introduction to Chemistry*. The method is easily enunciated—namely: Let the pupil be told as little as possible, and be made to discover as much as possible. The difficulty is in the application thereof, and no book that we know of is capable of solving this difficulty. It will pay you best to think out a course of experiments, and then to ask yourself how far it will be possible to set the students to discover the truths that are to be demonstrated by the experiments. We remember a very useful lecture on the subject of the heuristic method that appeared in *The Educational Times* some months ago. The editor will be able to tell you exactly when, and maybe the number is still obtainable.

Arbela.—A lighthouse, whose height is known to be 80 feet, stands on a vertical rock; the angles subtended by the lighthouse and rock at the eye of an observer in a boat at sea-level are found to be each 30°. Find the height of the rock, and its distance from the boat.

Let D represent the position of the observer, OC the sea-level, CB the vertical height of the rock above sea-level, and BA the height of the lighthouse. Then BA is 80 feet, and each of the angles AOB, BOC is 30°. Hence $\angle AOC$ is 60°.

$$\therefore \frac{AC}{CO} = \tan 60°, \text{ and } \frac{BC}{CO} = \tan 30°.$$

$$\therefore \frac{AC}{CO} \times \frac{CO}{BC} = \frac{\tan 60°}{\tan 30°}.$$

$$\therefore \frac{AC}{BC} = \frac{\sqrt{3}}{\frac{1}{\sqrt{3}}} = 3.$$

$$\therefore AC = 3BC.$$

$$\text{But } AC = AB + BC$$
$$= 80 + BC.$$

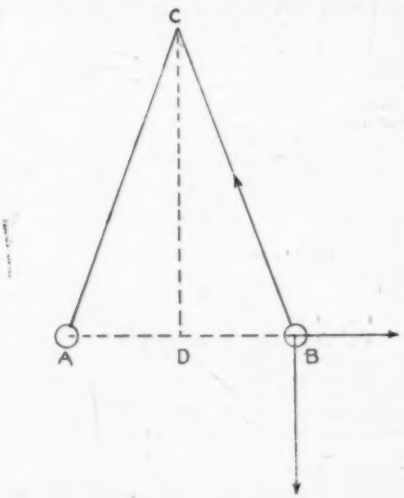
$$\therefore 80 + BC = 3BC.$$

$$\therefore BC = \underline{40 \text{ feet.}}$$

$$\text{Again, } \frac{OC}{CB} = \tan OBC = \tan 60° = \sqrt{3}.$$

$$\therefore OC = CB\sqrt{3} = 40\sqrt{3} = \underline{69{\cdot}28 \text{ feet.}}$$

Magnis.—Two small spherical pith balls, each one decigram in weight, are suspended from a point by threads 50 cm. long, and are equally charged so as to repel each other to a distance of 20 cm. Find the charge on each, in electrostatic units. ($g = 980$.) (Board of Education, Adv. Elect. and Mag., May 1901.)



Let q be the charge, in electrostatic units, on each ball. Then, since the charges are at a distance of 20 cm. apart, the repulsive force (in dynes) between them will be equal to f, where $f = \frac{q^2}{(20)^2} = \frac{q^2}{400}$.

Let A and B be the two charged balls, suspended by threads from the point C. Join the centres of A and B,

and from C drop the perpendicular CD on to the straight line AB.

The ball B is in equilibrium under the action of the following forces :—

1. A force equal to (mass of ball × acceleration of gravity) = ·1 × 980 = 98 dynes, acting vertically downwards.

2. A horizontal force, equal to $\frac{q^2}{400}$, acting in the direction DB.

3. A tension along the thread CB.

Since these forces are respectively parallel to the sides CD, DB, and BC of the triangle CDB, they are proportional to these sides, by the triangle of forces. Thus,

$$\frac{\text{electrostatic repulsion along DB}}{\text{gravitation pull toward earth}} = \frac{\frac{q^2}{400}}{98} = \frac{\text{DB}}{\text{CD}}.$$

Also, DB = 10 cm., BC = 50 cm., and CD = $\sqrt{(\text{CB})^2 - (\text{DB})^2}$
$= \sqrt{2500 - 100} = \sqrt{2400} = 49$ cm.

Thus, $\frac{q^2}{400} = 98 \cdot \frac{10}{49} = 20.$

$\therefore q^2 = 8000$;

$q = \sqrt{8000} = 89{\cdot}5$ electrostatic units.

Bike.—Give a graphical representation for all real values of x of the expressions $\sin x \cos x$, $x^2 - \frac{1}{x}$, $\frac{x}{(x-1)(x+1)}$.

(B.Sc., London, 1899.)

Denoting each of the given functions by y, we have, in case of the first, $y = \sin x \cos x = \frac{1}{2} \sin 2x$.

Taking values of x between $\pm \infty$, and calculating the corresponding values of y, we plot the former as abscissæ and the latter as ordinates, and draw a curve through the points thus obtained. This is a *graph* of the function.

We may take the circular measures of 0°, 7·5°, 15°, 22·5°, ... 90° along Ox, and the values of half the sines of 0°, 15°, 30°, 45°, ... 180° along the axis of y. The graph obtained is shown in Fig. 1. It is obvious that this goes to ∞ on either side the axis Oy, the wave form being repeated an indefinite number of times.

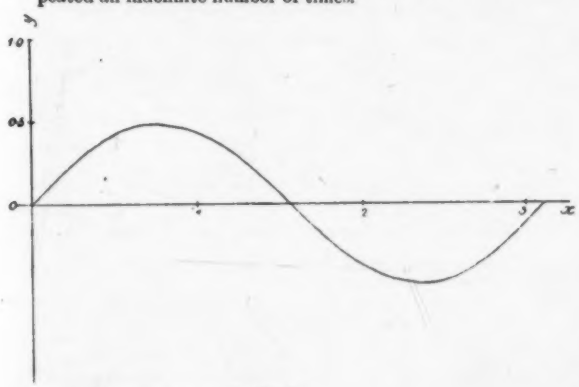


Fig. 1.

Next, let $y = x^2 - \frac{1}{x}$.

Obtaining $\frac{d^2y}{dx^2}$, we find the point (1, 0) is a point of inflection. Also, from $\frac{dy}{dx}$, we see that the curve turns at about $x = -0{\cdot}8$. Again, when $x = 0$, $y = \infty$, and when $x = \pm \infty$, $y = \infty$.

Taking values of x between -2 and 2, we have :—

When $x = -2$, $y = 4 + \frac{1}{2} = 4{\cdot}500.$

,, $x = -1{\cdot}4$, $y = 1{\cdot}96 + \frac{1}{1{\cdot}4} = 2{\cdot}674.$

,, $x = -1$, $y =$ . . . $= 2{\cdot}000.$

,, $x = -{\cdot}8$, $y = 0{\cdot}64 + \frac{1}{0{\cdot}8} = 1{\cdot}890.$

,, $x = -{\cdot}6$, $y = 0{\cdot}36 + \frac{1}{0{\cdot}6} = 2{\cdot}027.$

,, $x = -{\cdot}4$, $y = 0{\cdot}16 + \frac{1}{0{\cdot}4} = 2{\cdot}660.$

. . . . . .

,, $x = 0$, $y =$ . . . $= \infty.$

,, $x = 0{\cdot}4$, $y = 0{\cdot}16 - \frac{1}{0{\cdot}4} = -2{\cdot}34.$

,, $x = 0{\cdot}8$, $y = 0{\cdot}64 - \frac{1}{0{\cdot}8} = -0{\cdot}61.$

,, $x = 1{\cdot}0$, $y =$ . . . $= 0{\cdot}00.$

,, $x = 1{\cdot}4$, $y = 1{\cdot}96 - \frac{1}{1{\cdot}4} = 1{\cdot}246.$

,, $x = 2$, $y = 4 - \frac{1}{2} = 3{\cdot}5.$

Plotting these values of x and y, we obtain the graph shown in Fig. 2, where the scale taken for the ordinates is one-fourth of that taken for the abscissæ.

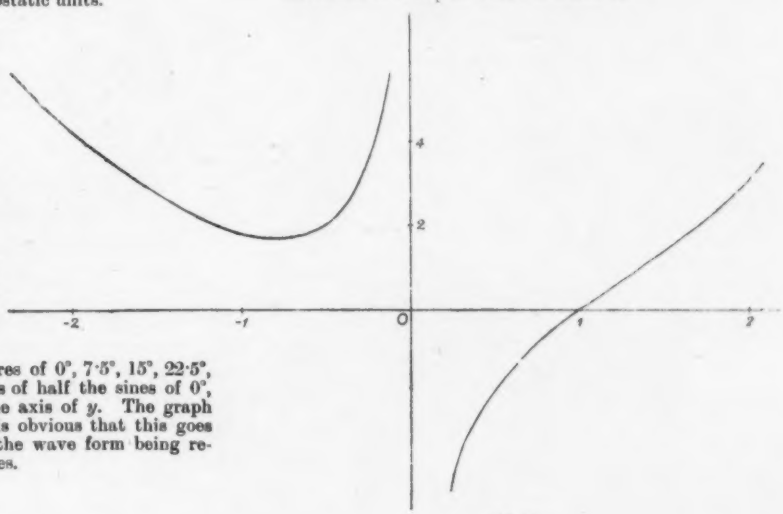


Fig. 2.

For the third of the given expressions,

$$y = \frac{x}{(x-1)(x+1)}.$$

This may be written in either of the forms—

$$y = \frac{x}{x^2 - 1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$\text{or, } y = \frac{1}{2}\left(\frac{1}{x-1} + \frac{1}{x+1}\right) \quad . \quad . \quad . \quad (2)$$

From (1)—

When $x = 0$, $y = 0$.

,, $x = 0{\cdot}2$, $y = \frac{0{\cdot}2}{0{\cdot}04 - 1} = -\frac{0{\cdot}2}{0{\cdot}96} = -0{\cdot}208.$

,, $x = 0{\cdot}4$, $y = \frac{0{\cdot}4}{0{\cdot}16 - 1} = -\frac{0{\cdot}4}{0{\cdot}84} = -0{\cdot}476.$

,, $x = 0{\cdot}6$, $y = \frac{0{\cdot}6}{0{\cdot}36 - 1} = -\frac{0{\cdot}6}{0{\cdot}64} = -0{\cdot}938.$

,, $x = 0{\cdot}8$, $y = \frac{0{\cdot}8}{0{\cdot}64 - 1} = -\frac{0{\cdot}8}{0{\cdot}36} = -2{\cdot}222.$

,, $x = 1{\cdot}0$, $y =$ . . . . . $\infty.$

,, $x = 1{\cdot}2$, $y = \frac{1{\cdot}2}{1{\cdot}44 - 1} = \frac{1{\cdot}2}{0{\cdot}44} = 2{\cdot}727.$

,, $x = 1{\cdot}4$, $y = \frac{1{\cdot}4}{1{\cdot}96 - 1} = \frac{1{\cdot}4}{0{\cdot}96} = 1{\cdot}458.$

,, $x = 1{\cdot}6$, $y = \frac{1{\cdot}6}{2{\cdot}56 - 1} = \frac{1{\cdot}6}{1{\cdot}56} = 1{\cdot}026.$

,, $x = 1{\cdot}8$, $y = \frac{1{\cdot}8}{3{\cdot}24 - 1} = \frac{1{\cdot}8}{2{\cdot}24} = 0{\cdot}804.$

When $x = 2{\cdot}0$, $y = \dfrac{2}{4-1} = \dfrac{2}{3} = 0{\cdot}667$.

From (2)—

When $x = 3$, $y = \frac{1}{2}\left(\frac{1}{2}+\frac{1}{4}\right) = \frac{3}{8} = 0{\cdot}375$.

,, $x = 4$, $y = \frac{1}{2}\left(\frac{1}{3}+\frac{1}{5}\right) = \frac{4}{15} = 0{\cdot}267$.

,, $x = 5$, $y = \frac{1}{2}\left(\frac{1}{4}+\frac{1}{6}\right)$, etc., etc.

,, $x = \infty$, $y = 0{\cdot}000$.

We see that the axis of x and the ordinates at $x = 1$, $x = -1$, are asymptotes, and the origin is a point of inflection. Further, we do not alter equation (1) by changing the signs of x and y; hence the graph will be symmetrical in opposite quadrants.

Plotting x apd y, we obtain the graph shown in Fig. 3.

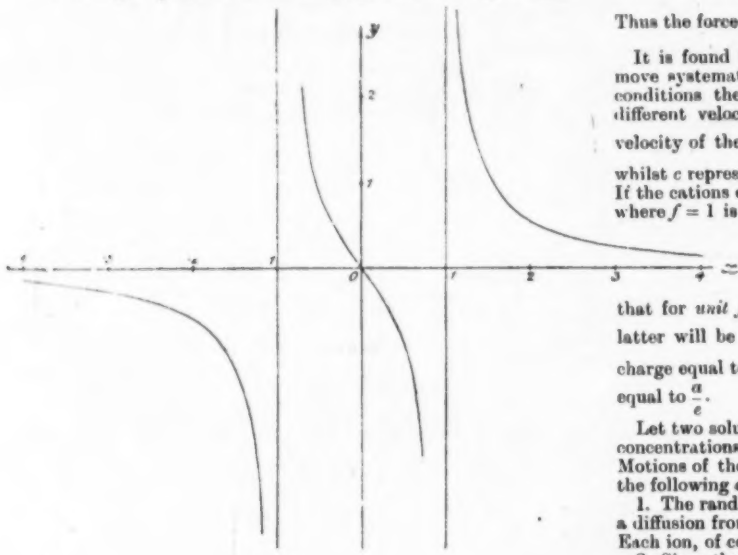


Fig. 3.

A. W.—You will probably find Gibson's *Elementary Treatise on the Calculus* (Macmillan and Co.) useful as a supplement to Edwards's and Edser's works on the calculus. The subject is treated in a very systematic manner, and the book is well provided with instructive problems. The chapter on Differential Equations covers the requirements of the Sixth Stage, Board of Education Examination.

Electrox.—Obtain an expression for the E.M.F. arising from difference of concentration in an electrolyte.

(Board of Education, Elec. and Mag., Hon. II., 1901.)

According to modern theory, the molecules of a substance in solution are in many respects under the same conditions as the molecules of a gas or vapour; they are, comparatively speaking, free of each other, and are moving with a velocity such that the kinetic energy due to the translational velocity of a molecule is equal to the energy due to the translational velocity of a hydrogen molecule in the gaseous state at the same temperature. The freely-moving molecules of the dissolved substance exert a pressure (osmotic pressure) just as the molecules of a gas do. In dilute solutions, the relation between the pressure p and the volume v_1 occupied by a gram of dissolved substance, is given by the equation

$$pv_1 = RT,$$

where R is a constant, and T is the absolute temperature. If v is the volume occupied at the temperature T by M grams of the dissolved substance, then

$$pv = MRT.$$

$$\therefore p = \frac{M}{v}, \quad RT = \rho RT,$$

where ρ is the mass of dissolved substance per c.c. of solution, or the concentration of the solution. Further, if there are n molecules, each of mass m, per c.c. of the solution, then $\rho = nm$, and $p = nmRT$. . . . . (1)

In the case where the solution is electrically conducting, the molecules of the dissolved substance are supposed to be dissociated into ions, of which the metallic (or equivalent) ions carry positive charges, and the remaining ions carry equal negative charges. Thus, in solution, hydrochloric acid (HCl) is dissociated into H ions carrying + charges, together with Cl ions carrying equal − charges. The +tively charge ions are termed *cations*, whilst the −tively charge ions are termed *anions*. Let us now suppose that a definite potential difference (PD) is maintained between two parallel planes of the solution.

Let V and V + dV be the potentials at two neighbouring points at a distance dx apart. In moving a + unit of electricity from one point to the other, the work done is equal to dV ergs. Thus, if f is the force acting on *unit charge*,

$$f dx = dV. \quad \therefore f = \frac{dV}{dx} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Thus the force acting on a charge e will be equal to $e\dfrac{dV}{dx}$.

It is found that for a given value of f the charged ions move systematically with given velocities. Under similar conditions the anions and cations generally travel with different velocities in opposite directions. Let a be the velocity of the anions when the value of f or $\dfrac{dV}{dx}$ is unity, whilst c represents the corresponding velocity of the cations. If the cations carry a charge + e, then the force on a cation where $f = 1$ is equal to $e \times 1$. The velocity of the ions has been found to be proportional to the value of $\dfrac{dV}{dx}$ at the point where they happen to be situated; it thus follows that for *unit force* acting on a cation, the velocity of the latter will be equal to $\dfrac{c}{e}$. Since the anions each carry a charge equal to − e, their velocity due to unit force will be equal to $\dfrac{a}{e}$.

Let two solutions of the same substance, but of different concentrations, be separated by a porous diaphragm. Motions of the ions occur through the diaphragm owing to the following causes:—

1. The random motions of the ions produce, on the whole, a diffusion from the more to the less concentrated solution. Each ion, of course, carries its charge with it.

2. Since the cations and anions, carrying opposite charges, move with different velocities, there will be a potential difference established between the opposite sides of the diaphragm. The potential gradient $\dfrac{dV}{dx}$ thus established at any point will tend to move the ions in opposite directions.

3. When a steady state is reached, the opposite ions must migrate through the diaphragm with equal velocities in opposite directions.

Let the area of the diaphragm be equal to A, and let us determine the velocities of the ions through a very thin layer of the diaphragm. Let the thickness of this layer be dx, and let V and V + dV be the potentials on opposite sides of it. The force acting on a cation will be $e\dfrac{dV}{dx}$, whilst a numerically equal force, acting in an opposite direction, will act on each anion.

Let p and $p + dp$ be the osmotic pressures, per unit area, on opposite sides of the layer: the difference of pressure, dp, is due to the difference of concentration on opposite sides of the layer. The resultant force on the whole of the layer is equal to Adp. If there are n ions of either sign per c.c. of the layer, the total number of ions of either sign within the layer is equal to nAdx. Since the force Adp is shared amongst nAdx ions, the force per ion is equal to

$$\frac{A\,dp}{nA\,dx} = \frac{1}{n}\frac{dp}{dx}.$$

Thus total force on cation

$$= \frac{1}{n}\frac{dp}{dx} + e\frac{dV}{dx},$$

and velocity of cation

$$= c\left(\frac{1}{n}\frac{dp}{dx} + e\frac{dV}{dx}\right).$$

Total force on anion

$$= \frac{1}{n}\frac{dp}{dx} - e\frac{dV}{dx},$$

and velocity of anion

$$= \frac{a}{e}\left(\frac{1}{n}\frac{dp}{dx} - e\frac{dV}{dx}\right).$$

Since these velocities are to be equal,

$$\frac{c}{e}\left(\frac{1}{n}\frac{dp}{dx} + e\frac{dV}{dx}\right) = \frac{a}{e}\left(\frac{1}{n}\frac{dp}{dx} - e\frac{dV}{dx}\right).$$

$$\therefore (c+a)\frac{dV}{dx} = \frac{a-c}{ne}\frac{dp}{dx},$$

or,

$$dV = \frac{a-c}{a+c}\cdot\frac{dp}{ne}.$$

From (1), $dp = m\mathrm{R}\mathrm{T}dn$, when T is constant.

$$\therefore dV = \mathrm{R}\mathrm{T}\frac{m}{e}\cdot\frac{a-c}{a+c}\frac{dn}{n}. \quad . \quad . \quad . \quad (3)$$

Let there be n_1 ions of either sort per c.c. on one side of the diaphragm, whilst there are n_2 ions per c.c. on the opposite side of the diaphragm. Then integrating (3) between opposite sides of the diaphragm, we get—

$$\mathrm{V}_2 - \mathrm{V}_1 = \mathrm{R}\mathrm{T}\frac{m}{e}\cdot\frac{a-c}{a+c}(\log_e n_2 - \log_e n_1)$$

$$= \mathrm{R}\mathrm{T}\frac{m}{e}\cdot\frac{a-c}{a+c}\log_e\frac{n_2}{n_1},$$

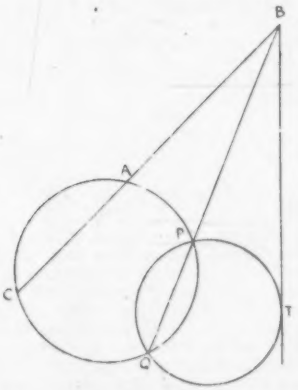
where $\mathrm{V}_2 - \mathrm{V}_1$ is the total P.D. between opposite sides of the diaphragm. This is the E.M.F. arising from difference of concentration in a cell. It is easy to interpret the symbols.

From the equation for 1 gram of the substance, $pV = RT$, it follows that

$$pdV = \mathrm{R}dT. \quad \therefore \mathrm{R} = \frac{pdV}{dT},$$

or R is the mechanical equivalent of the specific heat of expansion per gram of perfect gas. For hydrogen, R is accidentally equal to J, the mechanical equivalent. The ratio $\frac{m}{e}$ is the electrochemical equivalent of the cation. The quantities a and c are the respective velocities of the anions and cations under unit potential gradient. Values of these constants have been determined experimentally. Finally, the ratio $\frac{n_2}{n_1}$ is equal to the ratio of the numbers of molecules of the dissolved substance per c.c. (or per litre) of the solution, on opposite sides of the diaphragm. Ostwald has constructed cells comprising similar metallic electrodes, but each containing two different concentrations of the same solution. When a and c are unequal, the E.M.F. may amount to a large fraction of a volt.

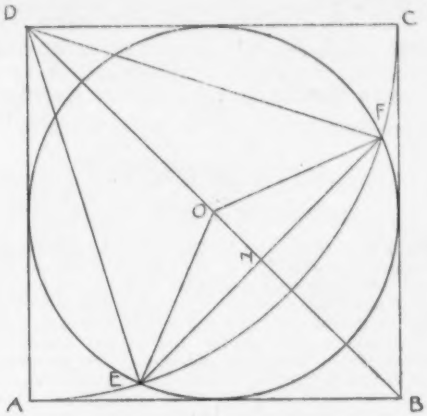
M.S.S.—Having given a fixed circle, and two fixed points A and B in its plane outside the circumference, draw through B any straight line cutting the fixed circle in P and Q. Show that the centre of the circle circumscribing the triangle APQ lies on a fixed straight line for all directions of the secant through B. (Science and Art, Stage 2, June 1900.)



Let PQT be the given fixed circle. Draw in any direction the secant BPQ. Draw QPA, the circle passing through the three points Q, P, A. Draw BT, the tangent from B to the fixed circle PQT. Produce BA to cut the circle QPA in C. Then we have $\mathrm{CB}.\mathrm{BA} = \mathrm{QB}.\mathrm{BP} = \mathrm{BT}^2$.

Now, BA and BT are fixed lengths, therefore BC is fixed in magnitude; and it is fixed in direction, since B, A are fixed points. Hence the circle QPA passes through the two fixed points A, C for all directions of the secant BQ. And the centre of the circle QPA lies on the line which bisects AC at right angles.

Zeta.—ABCD is a square, and O is the centre of the inscribed circle. The circle described with centre D and radius DA meets the inscribed circle in E and F, and EF meets OB in N. Show that OD is four times ON. (Cambridge Senior, 1898.)



In the triangles EDO, FDO,
DE = DF, DO is common, and EO = FO.
$\therefore \angle \mathrm{EDO} = \angle \mathrm{FDO}$.
Again, ED, DN = FD, DN, each to each;
and $\angle \mathrm{EDN} = \angle \mathrm{FDN}$.
$\therefore \angle \mathrm{DNE} = \angle \mathrm{DNF}$.
Hence EF is at right angles to DN.
Then because, from the vertex E of the triangle DOE, EN has been drawn perpendicular to the base DO, therefore

$$\mathrm{DE}^2 = \mathrm{DO}^2 + \mathrm{OE}^2 + 2\mathrm{DO}.\mathrm{ON}.$$

But $\mathrm{DE}^2 = \mathrm{DA}^2 = 4\mathrm{OE}^2$.

$$\therefore 4\mathrm{OE}^2 = \mathrm{DO}^2 + \mathrm{OE}^2 + 2\mathrm{DO}.\mathrm{ON}.$$

Again, $\mathrm{DO}^2 = 2\mathrm{OE}^2$.

$$\therefore 4\mathrm{OE}^2 = 2\mathrm{OE}^2 + \mathrm{OE}^2 + 2\mathrm{DO}.\mathrm{ON}.$$

$$\therefore \mathrm{OE}^2 = 2\mathrm{DO}.\mathrm{ON}.$$

$$\therefore \tfrac{1}{2}\mathrm{DO}^2 = 2\mathrm{DO}.\mathrm{ON}.$$

$$\therefore \mathrm{DO}^2 = 4\mathrm{DO}.\mathrm{ON}.$$

Hence DO = 4ON.

E. T. Fyle.—Nixon's *Euclid Revised* would probably meet your requirements. It is published at the Clarendon Press, Books I. and II. separately, at 1s. 6d.

Vaterland.—$(x-a)(y-b) = (x-a')(y-b') = (x-a'')(y-b'')$. Find the conditions that the solution of the above should be indeterminate. (Oxford and Cambridge School Exam. Board.)

$$xy - bx - ay + ab = xy - b'x - a'y + a'b' = xy - b''x - a''y + a''b''.$$

$$bx + ay - ab = b'x + a'y - a'b' = b''x + a''y - a''b''.$$

$$(b-b')x + (a-a')y = ab - a'b'.$$

$$(b'-b'')x + (a'-a'')y = a'b' - a''b''.$$

$$y = \frac{ab - a'b'}{a-a'} - \frac{b-b'}{a-a'}x.$$

$$(b'-b'')x + (a'-a'')\left\{\frac{ab-a'b'}{a-a'} - \frac{b-b'}{a-a'}x\right\} = a'b' - a''b'',$$

$$\left\{(b'-b'') - (a'-a'')\frac{b-b'}{a-a'}\right\}x = a'b' - a''b'' - (a'-a'')\frac{ab-a'b'}{a-a'}.$$

$$[(a-a')(b'-b'') - (a'-a'')(b-b')]x = (a-a')(a'b'-a''b'') - (a'-a'')(ab-a'b').$$

$$\therefore x = \frac{(a-a')(a'b'-a''b'') - (a'-a'')(ab-a'b')}{(a-a')(b'-b'') - (a'-a'')(ab-a'b')}.$$

Similarly,

$$y = \frac{(b-b')(a'b'-a''b'') - (b'-b'')(ab-a'b')}{(b-b')(a'-a'') - (b'-b'')(ab-a'b')}.$$

The values obtained for x and y become indeterminate if $a = a' = a''$, and $b = b' = b''$.

Held over till next month: *Calorie, Arum, J. W. Grant, H.P., Sha, Rex, Eurasian, Flora, M.M., Bike.*

OUR SCIENCE SECTION

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PHYSIOGRAPHY.

(ADVANCED AND HONOURS.)

The Recent Earthquake in Transcaucasia.—On February 13 a disastrous earthquake, resulting in the loss of two thousand lives, was experienced at and around Shemakha in Transcaucasia. The first shock was felt about midday, and, in a few minutes, churches and other buildings had fallen about the ears of the people. Subsequent shocks extended over several days. The correspondent of the *Standard* writes that the region is one in which shocks may continue for a long time. To the north rises the great chain of the Caucasus, a region of crystalline and sedimentary rocks bent into great folds, not less remarkable than those in the Alps. In such a locality earth-tremors are at any time possible. Elburz, the highest summit in the Caucasus, and Kasbek, which easily overtops Mont Blanc, are both extinct volcanic cones. Many more, though much smaller volcanoes, are scattered over the region south of the Caucasus. In fact, signs of volcanic action are abundant over a very large portion of the great upland plateau south of the Caucasus—the region where Turkey, Russia, and Persia meet. Ararat itself, though its crater has vanished, is an extinct volcano, for its rocks, where they disappear beneath the summit snows, are merely scoria. Moreover, the region has formerly suffered severely from earth-shocks, so that a renewal of earthquake activity is not surprising. The neighbourhood of Ararat was the scene of great activity in 1846. There was a severe earthquake in Asia Minor in 1855; and in all the region round about the Black and Caspian Seas, the eastern Mediterranean, and the valley of the Euphrates, shocks are not infrequent.

Radiants of Shooting Stars.—M. Bredikhine of St. Petersburg has lately had this question under study. The supposed existence of stationary radiant points (or radiant points of long duration) is an obstacle against all more or less admissible theories of shooting stars. Taking advantage of the 918 meteoric orbits calculated by J. Kleiber in 1891, and of subsequent data, the author concludes that each stationary (or long duration) radiant consists of several individual radiants, even when these radiants do not much differ from one another in their dates. This means that each stationary radiant is a compound radiant which originates from several individual radiants, each of which has its own position in space and its own origin, and all of which are intersected by the orbit of the earth. Thus in the well-known radiant of β Persei he finds "13 or 14 different orbits—that is, as many different streams." Applying his explanation next to the polar stationary radiants of Mr. Denning, the author shows that in the radiant of ζ Draconis we may recognise "12 different individual streams apparently composing one single stationary radiant." The author's final conclusion is therefore: "A stationary radiant does not originate from a single individual stream or from one single comet; it must be named a compound radiant, because it is produced by several comets or independent streams."

The Origin of Jet.—The hard jet of Whitby appears to have been used in Britain in pre-Roman days: it is alluded to by Cædmon, and mentioned in 1350 in the records of St. Hilda's Abbey. It was formerly extensively mined in the cliffs of the Yorkshire coast, near Whitby and elsewhere, in Eskdale, Danby Dale, and in several of the dales that intersect the East Yorkshire moorlands. The hard jet occurs in the *Ammonites serpentinus* zone of the Upper Lias, frequently in the form of flattened masses or layers, which in rare cases have been found to reach a length of 6 ft. Parkinson, in his *Organic Remains of a Former World* (1811), speaks of jet, in some cases, as pure bituminised vegetable matter; and the majority of writers regard it as having been found as a product of alteration of plant tissues. On the other hand, it has been described as the result of the segregation of the bitumen in the intervals of the jet shales, which have sometimes formed pseudomorphs after blocks of wood. Professor Seward has recently examined several sections of Yorkshire jet in the British Museum, which he believes demonstrate the origin of this substance from the alteration of coniferous wood, and in part, at least, of wood of the Araucanian type.

The occurrence of specimens of silicified wood with a covering of jet is spoken of by Young in his *History of Whitby* (1817). Sections cut from specimens which consist in part of petrified wood and in part of jet enable us to trace a gradual passage from well-preserved Araucanian wood to pure jet, which again affords little or no evidence of its ligneous origin. The conclusion arrived at is that Whitby jet owes its origin to the alteration of coniferous wood.

Fogs.—The governing conditions in fog production are thus summarised in the *Nineteenth Century and After*. We may expect to be free from fogs so long as (1) the lower and upper currents of the atmosphere move from the same, or nearly the same, direction; and (2) the wind moves uniformly from about the same direction within a radius of about 100 miles horizontally. On the other hand, we may expect a dense fog in winter or haze in summer when, with copious radiation, clear or nearly clear sky, increasing cold and calm or a slight wind, the lower and upper currents, or two lower currents within a moderate distance of each other, move from opposite or greatly differing directions. The amount of haze or fog in these conditions, however, depends very largely on the difference of temperature of the two currents; and if they do not differ, there may be no fog. The worst fogs take place with the largest terrestrial radiation, the intimate mixture of two currents each differing in temperature, and prevailing calm or light airs.

Study of Snow Crystals.—Mr. W. Bently has secured from four to thirty-four photographs in nearly every great snowstorm that has passed over Vermont since 1884. With every picture he has recorded the temperature, the kind and heights of the clouds, the direction and velocity of each cloud stratum, the direction and velocity of the surface winds, and the hourly change in the form of the snow crystals. His photographs now number over eight hundred, no two of which are alike. His attempts to solve the mystery and reason of the formation of the various kinds of ice crystals with which we are familiar in snow has not been so successful as his industry deserved. Still he has established the fact that the most beautiful and perfect tubular crystals are mostly confined to the western and north-western areas of great storms, and the columnar and granular forms also have each their respective places.

Perplexing Energy.—The Becquerel rays that are emitted from the rare metals of the uranium ores—namely, polonium, radium, and actinium—discovered in 1898 and 1899, are as much as ever a puzzle, as the energy apparently is produced without perceptible loss or outside aid, and seems to be created out of nothing. Yet so potent is this perplexing radiation that the self luminosity of radium is sufficiently intense to make it possible to read writing; moreover, the emission is not sensibly diminished even at the lapse of a year. The metals impart fluorescence to such different substances as the diamond, paper, and alkalis. By the agency of the radiation oxygen is converted into ozone, glass and porcelain are discoloured, photographic plates are acted upon, the skin is affected, and the germinating power is taken from seeds. Theories of radiant energy must be considerably modified before they are capable of explaining the anomalous Röntgen and Becquerel rays.

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CHEMISTRY.

(ADVANCED AND HONOURS.)

BY T. CARTWRIGHT, B.A., B.SC.

Ethylene from Inorganic Sources.—In a recent journal of the Society of Chemical Industry, Messrs. Tucker and Moody describe the production of ethylene from inorganic sources. Since calcium carbide, when treated with water, evolves acetylene, and aluminium carbide evolves methane, it was hoped that a mixture of these carbides would give ethylene; but this was found not to be the case: only acetylene and methane were obtained. When, however, a mixture of barium silicide, which evolves hydrogen, with calcium carbide is accompanied by water, ethylene is present in the evolved gases to the extent of 2 or 3 per cent. If barium carbide is substituted for the calcium carbide, the gases contain up to 15 per cent. of ethylene.

Electrolytic Production of Caustic Alkalis and Chlorine.—At the Falls of Niagara, 3,000 horse-power of energy is now being applied to the Acker process for the production, by direct electrolysis, of anhydrous caustic soda and chlorine. The principle of the process is the decomposition of molten salt by the agency of a carbon anode and a kathode of molten lead. A lead sodium alloy is formed at the kathode, the circulation and renewal of the molten kathode material being effected by means of high-pressure steam and an injector. The lead sodium alloy is carried into a separate vessel and decomposed by steam with the formation of caustic soda, hydrogen, and lead, and if the steam supply is carefully regulated, the caustic soda can be obtained in the anhydrous condition. The hydrogen gas is collected and burnt, the heat of combustion being utilised for the initial heating of the rock salt to feed the cell.

Properties of Liquid SO_2.—It is found that liquid SO_2 dissolves a large number of binary inorganic salts, and most salts of inorganic bases. The solutions of these salts are good conductors of electricity. The simple laws which regulate the conductivity of aqueous solutions of salts are in general not valid for the sulphur dioxide solutions—for example, Kohlrausch's law for the independent wandering of ions, Ostwald's dilution law, the law according to which the molecular conductivity approaches to a maximum with increasing dilution, and the rule according to which the increase in the conductivity with the dilution is the same for all binary salts. The conductivity of solutions has been investigated at temperatures ranging from the freezing-point of liquid sulphur dioxide to its critical point. The molecular conductivity increases at first with the temperature, reaches a maximum at a temperature depending upon the nature of the dissolved salt, and then decreases with a further rise of temperature, becoming finally zero at the critical temperature, although the salts remain dissolved even at a temperature above the critical temperature. It is concluded from this that electrolytic dissociation in solution is an essential property of, or conditioned by, the liquid state of aggregation. Determinators of the molecular weights of dissolved salts by the boiling-point method give values higher than the normal, from which it would appear that the molecules of the dissolved salts are to a considerable extent polymerised, or form complex associated molecules containing molecules of the solvent.

The action of PCl_3 on $AgNO_3$ (Reply to "Scamp").—In acting upon PCl_3 with $AgNO_3$, the latter would, of course, be in aqueous solution, and the first reaction would not be between the PCl_3 and the $AgNO_3$, but between the water and the PCl_3, as follows:—

$$PCl_3 + 3HOH = P(OH)_3 + 3HCl.$$

The HCl thus formed would act upon the $AgNO_3$ as in Group I., with the formation of AgCl and HNO_3, so that the pure equation would be—

$$PCl_3 + 3HOH + 3AgNO_3 = P(OH)_3 + 3AgCl + 3HNO_3.$$

Hydrocarbons: Substitution Compounds.—We have already referred to the action of chlorine upon methane in the presence of sunlight as yielding CH_3Cl (chlor methane or methyl chloride), CH_2Cl_2 (di-chlor methane, or methylene chloride), $CHCl_3$ (tri-chlor methane, or chloroform), and CCl_4 (carbon tetra chloride). These substitution products are typical of the class which includes *all compounds made from hydrocarbons or other carbon compounds* by the replacement of one or more atoms of hydrogen by some other element or compound radical. The chief of these are the *halogen substitution products*, of which the above are examples. As an example, C_2H_5Br may be prepared by fitting a flask with a dropping funnel, containing bromine, and a delivery tube connected with a Liebig's condenser. In the flask is placed some red phosphorus, and the bromine is dropped in very slowly. After three hours the mixture is gently distilled by means of a water bath, and the distillate is shaken with two or three times its own volume of water, which is got rid of by means of a pipette and a few pieces of fused calcium chloride. The quantities to be used should be P 20 grams, Br 120 grams, C_2H_5OH 120 grams.

$$3C_2H_5OH + PBr_3 = C_2H_5Br + P(OH)_3.$$

It will be noted that we really substitute Br for the OH of ethyl alcohol, which reminds us of the fact that substitution is not only common to hydrocarbons, but also to their derivatives. The C_2H_5Br thus prepared is a sweet-smelling liquid, boiling at 38° C., and identical with the body resulting from the direct action of Br on ethane.

Oxidation Products.—Starting with the hydrocarbons, a series of compounds may be produced by the gradual oxidation of these. The first step cannot be taken directly in consequence of the difficulty of acting upon the hydrocarbons by reason of their inertness. This is most conspicuous with the most important series—namely, the paraffins, which are so called because of this inertness. If, however, a halogen substitution of a paraffin is heated with (1) water, (2) dilute aqueous alkalis, or (3) freshly-precipitated silver hydroxide, an alcohol is produced, thus:—

$$CH_3Br + KOH = CH_3OH + KBr,$$
$$C_2H_5I + AgOH = C_2H_5OH + AgI,$$

and this alcohol is the result of the first stage of hydrocarbon oxidation, OH being substituted for H. Alcohols are not produced by this method on a large scale. Methyl alcohol is prepared by the destructive distillation of wood, and ethyl alcohol by the fermentation of glucose, both of which operations the student should perform for himself. As alcohols are thus prepared from hydrocarbons, the presence of the group CH_3 and C_2H_5 in methyl and ethyl alcohols respectively may be assumed. It will, however, be necessary to prove that the O and the H are present in these bodies (which may be taken as typical alcohols) as hydroxyl. Acted upon by Na, H is evolved. This agrees with the behaviour of water, which we know contains the OH group. If added to H_2SO_4 or HNO_3 salts are produced—for example, $C_2H_5HSO_4$ and $C_2H_5NO_3$. This reaction resembles the formation of salts by the action of metallic hydroxides on acids. But the test for hydroxyl is either PCl_3 or PCl_5, generally the latter. The student will remember that, when acted upon by water, these chlorides yield phosphorous and phosphoric acid respectively. Thus—

$$PCl_5 + HOH = POCl_3 + 2HCl.$$

Analogous products result from the reaction of C_2H_5OH and PCl_5. Thus—

$$PCl_5 + C_2H_5OH = POCl_2 + C_2H_5Cl + HCl,$$

where a Cl atom evidently displaces an OH group. These three reactions—namely, (1) with Na, (2) with acids, and (3) with PCl_5—prove that the alcohols are hydroxyl compounds, hence the formulæ CH_3OH, C_2H_5OH, etc.

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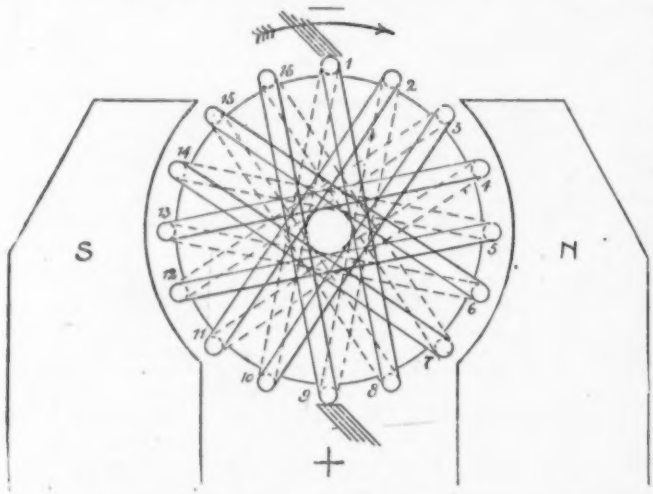
To remedy the disadvantages incident to a ring winding, another form of winding has been adopted. In this case the armature core takes the form of a solid cylinder, and all wires are wound over its external surface. To accomplish this, if a wire is wound from front to back on one side of the armature, it is connected with another wire on the opposite side of the armature, running from back to front. This process is continued until a closed circuit is formed. Since for every wire running from front to back there must be another wire running from back to front, it follows that the total number of wires on the outside of the armature must be even.

The figure will serve to explain the method of winding a drum armature with sixteen conductors. The core has the form of a solid cylinder with axis at right angles to the plane of the paper. On the curved surface of this cylinder, sixteen lines are marked off parallel to the axis. A wire must be laid along each of these lines, and connections made across the circular ends of the core, so that a closed winding is finally obtained. These end connections are represented in the figure. The connections across the front or near end of the core are represented by means of continuous lines, those across the back or far end of the core by broken lines.

From the front end of wire 1 we lead a connection to the front end of wire 8. Thus wires 1 and 8, which form parts of a single loop, are separated by 6 wires, or the *pitch* is equal to $6 + 1 = 7$. The same pitch is maintained throughout the winding. Thus the far end of wire 8 is connected with the far end of wire $8 + 7 = 15$, and then the near end of wire 15 is connected with the near end of a wire 7 in advance, or with wire 6. This process is carried on systematically, until finally the far ends of



wires 10 and 1 are connected together, when a closed winding is formed. It has already been pointed out that the total number of external wires must be even. It now becomes obvious that the pitch must be an odd number; for if this were not so, starting with a wire with an even number, we should only effect connections between wires of even numbers, and half of the external conductors would remain unconnected.

Our subsequent investigations will show that the pitch must be a sufficiently large number for it to be impossible for two wires directly connected with each other to simultaneously come under the same pole.

The peculiarities of this class of winding, as including the positions which the brushes must occupy, can be best made clear by means of a table. It can easily be seen that at the instant when the armature has the position indicated in the figure, each of the five wires lying under the N pole generates an E.M.F. acting from front to back of the armature, the direction of rotation of the latter being that indicated by the arrow. Similarly each conductor under the S pole generates an E.M.F. acting from back to front of the armature. The value of the E.M.F. generated by any wire is equal to VLB units (C.G.S.) or $\frac{VLB}{10^8}$ volts, where V is the velocity in cms. per second of the conductor, L is the length of the latter, and B is the number of lines of force per square cm. in the air gap.

We shall now start from wire 1, and follow the winding right round to the point whence we started. We shall take the E.M.F. generated by any one of the wires under a pole as unity. Thus in passing along any wire under a pole, the potential increases or diminishes by unity, according as the direction of the E.M.F. generated in that conductor agrees with the direction in which we are travelling, or is opposed to this. The columns headed D and U show the conductors down or up which we travel. The intermediate columns, headed F and U, indicate the potential of the front or back connections between the two conductors joined:—

U	F	D	B	U	F	D	B
1	0	8	0	15	1	6	2
13	3	4	4	11	5	2	5
9	5	16	5	7	4	14	3
5	2	12	1	3	0	10	0
1	0	8	0	15	1	6	2

We may take the potential of 1 as zero, so that the front connection between 1 and 8 is also zero. Wire 8 is not under a pole; in passing along it no difference of potential occurs, so that the back connection between 8 and 15 is also zero. Wire 15 is an active wire; in passing along it the potential rises by unity, since the direction of motion (from back to front) agrees with the direction of the E.M.F. Thus the front connection between 15 and 6 is at unit potential. In passing down 6 the potential increases by unity, so that the potential of the back connection between 6 and 13 is equal to 2. In passing up 13 another unit of potential is added, so that the front connection between 13 and 4 is at potential 3. Another unit of potential is added in passing down 4, so that the potential of the back connection between 4 and 11 is equal to 4 units. In passing up 11 another unit of potential is added, so that the potential of the front connection between 11 and 2 is equal to 5. Wires 2 and 9 do not produce E.M.F., so that the back connection between 2 and 9, and the front connection between 9 and 16, are both at potential 5. Note that wire 9 is at a potential 5 above wire 1; in other words, the difference of potential between wires 1 and 9 is equal to that due to 5 active wires, or the number of wires under either pole.

Wire 16 is inactive, and no P.D. occurs in traversing it. In passing up 7 we travel in a direction opposite to that of the E.M.F., and therefore one unit of potential is lost. The front connection between 7 and 14 is thus at potential 4. In going down 14 we are again opposed by the E.M.F., and a unit of potential is lost. The student should now find no difficulty in completing the table, when it will be noticed that the potential falls until we finally reach wire 1, from which we started, at which point the potential is once more zero.

We now see that with a symmetrical winding such as that indicated there will be no internal current in the armature circuit, since in going right round the circuit the E.M.S.'s generated by the conductors just cancel one another. On the other hand, if we connect wires 1 and 9 by means of brushes to an external circuit, a current will flow through the latter, since wire 9 is five units of potential higher than wire 1. Thus the lower brush is positive, the upper one is negative. Current leaves the dynamo at the positive brush, and enters it at the negative brush. Within the armature circuit the current divides into two branches; in one it flows along 1 – 8 – 15 – 6 – 13 – 4 – 11 – 2 – 9; in the other it flows along 1 – 10 – 3 – 12 – 5 – 14 – 7 – 16 – 9.

A glance at the above table shows another important fact. While wire 1 is at zero potential, wire 2 is at five units of potential, or between wires 1 and 2 there exists a P.D. equal to the full E.M.F. of the dynamo. This necessitates careful insulation of neighbouring wires. Usually the odd and even wires are wound in separate layers, one over the other, separated by an efficient layer of insulating material.

To prevent displacement of the wires, small wooden plugs, termed driving horns, are driven at intervals into the surface of the armature. These prevent the wires from slipping round the armature under the action of the forces called into play when a current is produced. The whole of the winding is then bound strongly in position by means of circular turns of steel or silicon bronze wire. These wires are, of course, carefully insulated from the conductors.

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So far in these notes, during the present session, it has not been possible to insert all that is necessary for examinational requirements. This more particularly applies to the sections dealing with statics and fluids. The reader is recommended to revise these from any text-book on the subject.

We may use this opportunity to draw attention to some of the remaining portions of dynamics. Thus the formula for kinetic energy, or $\frac{1}{2}mv^2$, when applied to a body in rotation, becomes $\frac{1}{2}w^2\mathrm{I}$, where w denotes the angular velocity of the body, and I its moment of inertia. The term *angular velocity* may be defined as follows:—When a point is moving in any manner in a plane, the rate at which the straight line (joining the moving point to a fixed point) is rotating is called the angular velocity of the moving point about the fixed point. If the moving point is describing the circumference of a circle with uniform velocity, all points in the line joining it to the centre will have the same angular velocity; the linear velocity will depend on the position or distance of the point from the centre. If V is the linear velocity in feet per second, and r the radius of the moving point, then $\mathrm{V} = wr$, or $w = \dfrac{\mathrm{V}}{r}$. Using this relation, $\frac{1}{2}mv^2$ may be written $\frac{1}{2}mw^2r^2$. Thus, if m_1, m_2, m_3 . . . denote the particles of a rotating body at distances r_1, r_2, r_3 . . . from the axis, then the kinetic energy is $\frac{1}{2}w^2(m_1r_1^2 + m_2r_2^2 + m_3r_3^2 \ldots)$.

$$\therefore \mathrm{KE} = \tfrac{1}{2}mw^2\Sigma mr^2.$$

The quantity Σmr^2, or *the mass of every small element or particle multiplied by the square of its distance, is called the moment of inertia*, and is often denoted by I. $\therefore \mathrm{KE} = \frac{1}{2}mw^2\mathrm{I}$.

The values of I for all the simple figures are known and tabulated. They may also be obtained by simple applications of the calculus. It may be advisable to commit to memory those for a line or rod, rectangle, and a circle.

Thus, for a rod of length l, so thin that its width may be neglected, if m denote the mass of unit length, then I for a small element δx, at a distance x from the axis, is $m\delta x \times x^2$; and the value for I for an axis passing through one end, and perpendicular to its length, is $m\Sigma x^2\delta x$. This, when the summation is effected, becomes $\dfrac{ml^3}{3}$.

The total mass of the rod ml may be denoted by M.

$$\therefore \mathrm{I} = \tfrac{1}{3}\mathrm{M}l^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1).$$

If k is a length such that if the whole mass could be assumed to act at the point, and the moment of inertia to be unaltered, then we have—

$$\mathrm{M}k^2 = \tfrac{1}{3}\mathrm{M}l^2.$$

$$\therefore k = \frac{l}{\sqrt{3}} = \cdot 577.$$

The distance k is called the *radius of gyration*. The value of I about an axis at right angles to the rod, and passing through its middle point, may be obtained from (1) by writing $\dfrac{l}{2}$ for l; and (1) becomes $\dfrac{\mathrm{M}l^2}{12}$ . . . . . (2).

If convenient to remember (2), the value of I in (1) can be obtained by using the rule—*The moment of inertia about a given axis is equal to the moment of inertia about a parallel axis passing through the centre of mass, together with the product of the mass and the square of the distance between the axes.*

Thus, to obtain Eq. (1) from (2), the mass is M, the square of the distance between the axes $\left(\dfrac{l}{2}\right)^2$.

$$\therefore \mathrm{I} = \tfrac{1}{12}\mathrm{M}l^2 + \frac{\mathrm{M}l^2}{4} = \tfrac{1}{3}\mathrm{M}l^2.$$

Circle.—The moment of inertia of a circle (such as a circular disc) about an axis perpendicular to its plane, and passing through its centre, is obtained by considering a thin ring of thickness δx at a distance x from the centre. The area of such a ring is $2\pi x\delta x$, its mass $m2\pi x\delta x$, and $\mathrm{I} = 2\pi mx\delta x \times x^2 = 2\pi mx^3\delta x$.

Hence, for disc, $\mathrm{I} = 2\pi m\Sigma x^3\delta x = \dfrac{\pi mr^4}{2}$.

The total mass $m\pi r^2$ may be denoted by M.

$$\therefore \mathrm{I} = \frac{\mathrm{M}r^2}{2}. \quad \text{Also, } \mathrm{M}k^2 = \frac{\mathrm{M}r^2}{2}. \quad \therefore k = \frac{r}{\sqrt{2}}.$$

Ex. 1. The mass of a disc is 100 lbs., and its diameter 3½ ft. If it turns round an axis 120 times a minute, find its kinetic energy. (1889.)

$$\text{Kinetic energy} = \tfrac{1}{2}w^2\mathrm{I}; \quad w = \frac{2\pi \times 120}{60} = 4\pi.$$

$$\mathrm{I} = \tfrac{1}{2}\mathrm{M}r^2 = \tfrac{1}{2} \times 100 \times \left(\tfrac{7}{4}\right)^2 = \frac{50 \times 49}{16}.$$

$$\therefore \text{Kinetic energy} = \tfrac{1}{2} \times 16\pi^2 \times \frac{50 \times 49}{16}$$

$$= 12{,}100 \text{ ft. poundals.}$$

Or, taking $g = 32$, this gives 378·1 ft. poundals.

Motion of a Projectile.—When a particle is projected from a given point with initial velocity V, and direction making an angle θ with the horizon, then neglecting the resistance of the air, or, better, assuming the motion to take place *in vacuo*, the position or velocity of the body at any subsequent time can be obtained by simple applications of the laws of motion.

The components of the velocity are V cos θ horizontally, and V sin θ vertically.

Denoting the velocity at a time t by v, and the corresponding space described by s, we may, from the equation $v = \mathrm{V}\sin\theta - gt$, find the time taken to reach the highest point. At this point the particle is for the instant considered at rest. $\therefore v = 0$.

Hence we have $\mathrm{V}\sin\theta = gt$. $\therefore t = \dfrac{\mathrm{V}\sin\theta}{g}$ . . . . (1).

The *time of flight* will obviously be twice that given by (1), or $\dfrac{2\mathrm{V}\sin\theta}{g}$.

If h denotes the greatest height to which the particle rises, then

$$h = \mathrm{V}t\sin\theta - \tfrac{1}{2}gt^2.$$

Substitute the value of t from (1), and we get—

$$h = \frac{\mathrm{V}^2\sin^2\theta}{2g} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2).$$

The space described, called the *range*, is the product of the horizontal component and time.

$$\therefore \text{Range} = \mathrm{V}\cos\theta \times \frac{2\mathrm{V}\sin\theta}{g} = \frac{\mathrm{V}^2\sin 2\theta}{g} \quad . \quad . \quad (3).$$

It will be obvious from (3) that as the sine and tangent of a small angle vary with the angle, the *range* varies very nearly with the angle when the angle of elevation is small.

Ex. 2. Find the range of a projectile (moving *in vacuo*) on a horizontal plane through the point of projection.

If the angle of elevation be small, show that the range varies very nearly with the angle. When the angle is 1°, and the velocity of projection 1200 feet a second, show that the range is about 1570 feet. (1901.)

From (3), where V = 1200, $\theta = 1°$, we have—

$$\text{Range} = \frac{1200^2 \times \sin 2°}{32}.$$

As the angle is small, the sine varies very nearly with the angle—that is, $2° = \dfrac{2 \times \pi}{180}$.

$$\therefore \text{Range} = \frac{1200^2 \times 2\pi}{32 \times 180} = 1570 \text{ feet.}$$

Ex. 3. Show that the kinetic energy of a body revolving with an angular velocity w about a given axis is $\frac{1}{2}w^2\mathrm{I}$.

The radius of gyration of a fly-wheel is 8 feet, its mass 30 tons, and it makes 20 revolutions per minute. Find its kinetic energy. Ans. 295009·5 ft. pounds.

Ex. 4. Find the moment of inertia of a circular disc about a diameter. (1900.)

Ex. 5. Prove that the moment of inertia of a body about a given axis is equal to the moment of inertia of the body about a parallel axis through the centre of mass, together with the product of the mass of the body and the square of the distance between the axes.

Find the radius of gyration of a uniform straight thin rod of length l, about an axis, through an extremity inclined to it at an angle α. (1901.)

Ex. 6. Find the radius of gyration of a circular lamina with respect to a diameter. (1898.)

Ex. 7. Determine the range and time of flight of a particle projected, *in vacuo*, from a point in a horizontal plane.

If A be the point of projection, B the extremity of the range, P any position of the particle during flight, and C the point where AP produced cuts a vertical through B, show that the point C moves downwards during flight with a velocity equal to the initial vertical velocity of the particle. (1898.)

Define moment of inertia. Find the moment of inertia of a circular lamina about an axis at right angles to its plane and passing through its centre. (1892.)

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INFLUENCE OF THE VAGUS NERVES ON HEART AND LUNGS.

AMONG many difficult points arising in teaching the advanced stage of human physiology, not one excels the actions of the vagus nerves in complexity, my experience being that students are apt to be much bewildered by the different effects on the heart and lungs. The following scheme seems to me to make the subject more graphic, and easier of remembrance. It more approaches an experimental knowledge. Unfortunately, such experiments being impossible in a science school, the students generally "cram" this portion of the syllabus in a parrot manner.

On the blackboard draw an outline sketch of the cerebrum, bulb (or medulla oblongata), and spinal cord, as in the diagram appended, where a cat's brain is represented. Sketch in also, at some distance lower down the board, the larynx, lungs, and heart—preferably putting the heart in red chalk, and the larynx in yellow. Take next some thick white blind-cord, and cut off two lengths, fixing the ends of these to the lower part of the bulb by a pin: these represent the superficial origins of the vagi. Fix the lower ends over the lungs, and also put a pin through the cords about three-quarters of the way down. Then tie on each side (at *a*) a piece of white twine to represent the cardiac branches, fixing these cords by two pins, one above, the other over, the surface of the heart. Lastly, draw two chalk lines from the upper part of the "vagi" to the larynx, as in the diagram: these represent the two superior laryngeal branches. Other branches are omitted, as not being germane to the subject. The model is now ready for demonstration, except that one may devise imaginary electrodes for stimulating the nerves from some fine battery wire attached to two narrow strips of copper foil. My method of explanation is much as follows:—

Section of one vagus produces little or no effect; but if both be divided, there are usually three chief phenomena to be seen in, say, the dog or rabbit—(*a*) slowing of respiration, with increase of depth in the breaths, so that the

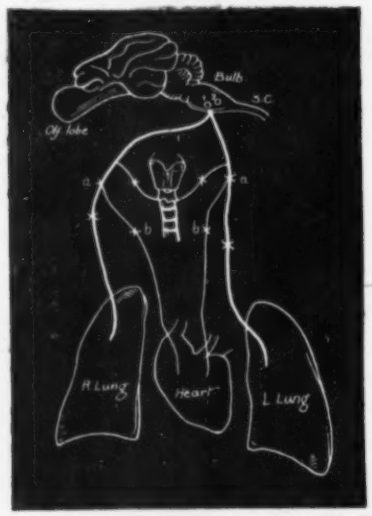

DIAGRAM OF CONNECTION OF VAGI TO BRAIN, HEART, LUNGS, AND LARYNX.

S.C. Spinal cord. 1. Respiratory centre. 2. Cardio-inhibitory centre. × Indicates points of section of nerves.

quantity of air entering the lungs is little altered in total amount; (*b*) great increase of heart rate; (*c*) no formation of gastric juice on entry of food into the stomach. The animals thus experimented on die, after varying intervals, of a form of inflammation of the lungs (so-called "vagus pneumonia").

Consider next the effect of stimulation of these nerves after section. Here it must be remarked that results are often discordant, owing to variations in the strength of electrical stimulus, and also, and more especially, to the fact that the anæsthetic necessary before these experiments can be carried out completely alters the state of affairs. Cutting out with scissors a piece of our nerve will remove the (imaginary) impulses passing downwards from the cardio-inhibitory centre in the bulb (2), and the heart will beat faster from lack of the restraining influence thus cut off—much as throwing the reins on a horse's back will cause a restive animal to bolt. If our electrodes are applied to the heart-ends (*b*), strong impulses are sent down, and the heart is slowed, or even stopped—equivalent to pulling our reins taut. In certain animals, after a time the inhibitory mechanism gets tired out, and the heart recommences to beat.

Turning now to the influence on respiration, we first divide the superior laryngeal branches, and stimulate the brain-ends of these nerves: respiration, according to Professor Foster, is slowed. This action may be remembered by the mnemonic "S." If, instead, we divide the main nerve below these branches, we have slowing of respiration, as mentioned earlier: application of our electrodes after excision to the central (brain-seeking) end will lead to hurried respiration. This result shows us that impulses are continually passing up from the lungs to the respiratory centre (1), the effect of section being to stop them: stimulation then will cause stronger impulses to reach the bulb, with increase of messages outwards to the respiratory muscles, and therefore increased efforts at breathing. In life, it is probably the continuous alteration of the size of the alveoli that generates these messages. The respiratory centre can, of course, be affected directly by circulation of blood deficient in oxygen, as in asphyxia. To complete the subject, one may mention that stimulation of the sensory ends of the glosso-pharyngeal nerves, either naturally by getting the animal experimented on to swallow some water, or by direct stimulation of the nerves, will lead to stoppage of breathing for a short time: this inhibition is shown in life by the inability to swallow and to breathe at the same time.

It is important to keep in mind the opposite effect of stimulation of the vagal trunks on the lungs and heart, determined by the different way messages are transmitted in relation to the two organs. The influence of acceleration of the sympathetic and the "depressor" effect on the heart hardly come into this paper, but must be fully understood to render study of the nervous influence complete.

SCIENCE NOTES.

Modern Methods of Spectrum Analysis, and some Results.

SIR NORMAN LOCKYER, in *Inorganic Evolution as Studied by Spectrum Analysis*, describes a method used for investigating the chemical constitution of the stars. It is found that the spectrum of a substance alters as the method of producing incandescence is varied. This is shown in Table A.

TABLE A.

VARIETIES OF SPECTRA.	METHODS OF PRODUCING INCANDESCENCE.	CHARACTERS OF SPECTRA.
1. Flame spectra.	Bunsen or blowpipe flame.	Few well-marked lines and flutings.
2. Arc spectra.	Electric arc.	Many lines (2,000).
3. Spark spectra.	High-tension electric spark, from induction coil and Leyden jars.	Small number of lines intensified (*enhanced lines*), and the others reduced in brightness.

The enhanced lines (that is, lines of spectra given by substances at extremely high temperatures) of the principal metallic elements have been determined and brought together so as to form what the author calls a "test spectrum." This has been compared with the spectra of the different heavenly bodies, and the presence in them of the various chemical elements determined. A chemical classification of the stars based on these investigations is suggested on the lines indicated in Table B.

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TABLE B.

Highest Temperatures.

CLASSES OF STARS.	CHARACTERS.	EXAMPLES.
Gaseous stars. Protohydrogen stars.	Giving *enhanced* hydrogen lines.	γ Argus and ϵ Orionis.
Gaseous stars. Cleveite gas stars.	Giving helium and associated spectra.	β Crucis. ζ Tauri and Algol.
Protometallic stars.	Giving *enhanced* metallic lines.	Rigel and Markab. α Cygni and Sirius.
Metallic stars.	Giving the "arc spectra" of metals.	Polaris & Procyon. Aldebaran, Arcturus, and the Sun.
Fluted spectra stars.	Fluted spectra.	Antares and 19 Piscium.

Lowest Temperatures.

It has been suggested that the differences in the spectra of stars are due to certain elements, or classes of elements, collecting together in one region of space, whilst other elements accumulate in other parts. To test the truth of this suggestion, the distribution of the different classes of stars in space has been investigated, and is indicated approximately in Table C.

TABLE C.

CLASSES OF STARS.	DISTRIBUTION.	DISTANCE FROM THE EARTH.
Gaseous stars.	Condensed in the Milky Way.	Greatest.
Protometallic stars.	Not confined to the Milky Way.	Intermediate.
Metallic stars.	Not confined to the Milky Way.	Smaller.
Fluted spectra stars.	Indefinite.	Indefinite.

The only class of stars showing marked condensation is the class of gaseous stars; but hydrogen is met with in all stars except the very coolest, and helium (one of the cleveite gases) is found in stars as far away from the Milky Way as the tail of the Great Bear and in the Sun. Hence it is concluded that the same chemical substances exist at all distances and in all directions throughout space.

Sir Norman Lockyer then tries to show that as the stars become cooler new elements appear. Thus, beginning with the hottest stars, we have principally hydrogen, or even some simpler substance, present, with traces of the cleveite gases. In the next cooler class of stars we still find hydrogen, etc.; but oxygen and nitrogen appear together, with enhanced lines of magnesium, calcium, etc. Next we find silicium appearing, and later the enhanced lines of iron and titanium are found. When the cooler stars are reached, the spectra become much more complicated, yielding the arc lines of the metallic elements. It is significant that the simplest substances, as shown by their lower atomic weights, appear first, and that the more complex or heavier substances appear later.

There have been suggested three ways in which the elements, as we know them, may have been evolved:—

1. By polymerisation, or the combination in different amounts and varying arrangement of similar minute particles.
2. By the combination in many different ways of a few dissimilar minute particles.
3. By the building up of physical complexes from similar particles associated in varying amounts with electricity or ether.

Metals in the Earth and Stars.

Professor Suess, the eminent geologist, has sent to Sir Norman Lockyer some important remarks, which are reproduced in *Nature*, October 24, 1901.

The earth is regarded as a globe of NiFe, covered with a siliceous slag, which is divided into two layers:—

1. Outer, lighter layer, rich in SiAl (trachyte, granite, and other acid rocks).
2. Lower, heavier layer, rich in SiMg (peridotite, olivine, and other basic rocks), and containing NiFe and its associated minerals.

By an extension of the work of Professor Vogt on the metals characteristic of the different classes of rocks, Professor Suess gives the following elements as characteristic of the various classes:—

1. *Acid Rocks*—Si, K, Li, Al, W, U, Ce, Sn, Zr, Th, and Y; with which are found Be, Cu, B, and F.
2. *Basic Rocks*—Ca, Mg, Fe, Ni, Co, Cr, Cu, Ti, Pt, C, and S; and with these are found Si, Al, Ba, Sr, Mn, V, P and Cl.
3. *Ultrabasic Rocks*—Fe, Ni, Co, Cr, Cu, C, , S, and Cl; which are joined together by SiO_2, MgO, and CaO.

Two varieties of ultrabasic rocks are recognised—

(*a*) *Oxydic rocks*, characterised by prevalence of Ti.

(*b*) *Sulphidic rocks*, yielding the nickeliferous sulphide of iron.

Lockyer has determined the presence of the enhanced lines of the following elements in spectra of the sun's chromosphere and of α Cygni—Mg, Ca, Fe, Ti, Mn, Ni, Cr, V, Cu, Sr, and Si; and he further notes that in γ Cygni Ti is prevalent (oxydic), in α Cygni Fe, Cr, and Ni (sulphidic), and in β Orionis (Rigel) Si and Mg preponderate.

Two explanations are suggested by Professor Suess for this close parallelism between the ultrabasic rocks of the earth's crust, on the one hand, and α Cygni and the sun's chromosphere, on the other:—

1. Metallic vapours corresponding to those from the acid rocks are less represented in the sun and stars than those from basic rocks; or
2. There is some secondary cause for the parallelism, such as the nature of the spectra of the basic metals, which gives them an apparent prevalence in star spectra.

Variation of Latitude.

If the axis of the earth is subject to variation, it must be so small in amount as to have no appreciable effect on climate or the length of day and night. Two methods of investigating the subject have been adopted:—

1. *Mathematical.*—Euler calculated that the axis of a globe of rigid matter of the size and shape of the earth, and spinning at the same rate as the earth, would vary in a regular manner. The cycle of variations, he found, would be completed in ten months. Search was made among the records of observations of latitude to determine a ten months' period, but none was found. Professor Newcomb discovered later that Euler was wrong in assuming the earth to be rigid, and that, by allowing for the plasticity of the earth in the calculations, a longer period was obtained, which was more in accordance with observation.

2. *Observational.*—Mr. Chandler in America and Dr. Küstner of Berlin independently observed slight movements of the pole—so slight that it is never more than twelve yards away from its mean position. Mr. Chandler then examined the records of latitude observations to discover traces, not of a ten months' period, but of variations having periods of any length. He found that the variation of the earth's axis completes a cycle on an average in 428 days; but superposed on this variation he found others, which have been ascribed to various causes.

Attempts have recently been made by J. Halm (*Nature*, March 8 and September 6, 1900) to trace a connection between variations of the axis of rotation, on the one hand, and the earth's magnetism and solar activity, as shown by sun spots, on the other hand. He shows, by curves extending backwards for sixty years, that the radius of the circle described by the pole is greatest when sun spots are least frequent (for example, in 1900), and that the radius decreases as the sun spots increase in number (maximum, 1893 and 1904). Further, a close connection has been traced between the frequency of sun spots, auroral displays, and magnetic storms; and by comparing these with the amount of variation of latitude, this latter is found apparently to depend largely on one or all of the former. Thus it may be noticed that earth magnetic disturbances show maxima at the equinoxes and minima at the solstices. The effect of this is seen in the fact that the pole traces out an ellipse, being at the greatest distance from the centre at the solstices, and at the least distance at the equinoxes.

In explanation of these variations, Halm calls attention to Joule's experiments, in which he found that magnetic strain produced molecular displacement in iron bars. It is known that the earth's magnetic axis is inclined to the axis of rotation at an angle of about 12°. Molecular strain along this axis would produce a change of form, and therefore change of the axis of rotation of the earth, and the amount of the change would vary according to the amount of the magnetic forces.

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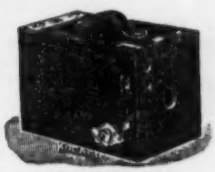

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GERMAN PRIZE COMPETITION.
(Ordinary Competition.)

Die Stiefmutter fragt sich mit tiefem Schmerze, woher das komme, und sie kann keine Antwort finden. Arme Frau! Du webst emsig und unermüdlich dein Gewebe von Liebe um das Herz des dir anvertrauten Kindes und du weisst nicht, dass hinter deinem Rücken eine böse Penelopeia sitzt, die Nachts immer wieder auftrennt, was du tagüber gewoben hast! Da sind zunächst die Verwandten der ersten Frau; aus Pietät für die Todte begehen sie eine Rücklosigkeit an der Lebenden; so oft das Kind zu ihnen kommt, hört es sich bedauern, beseufzen, beweinen; man spricht ihm von seiner Mama, nicht der neuen, denn die sei es ja nicht, sondern der alten, wie ganz anders sie es geliebt habe, wie ganz anders die es halten würde; man fragt es nach dem Thun und Lassen der Fremden, des Eindringlings und ob sie es ihm Böses zufüge; da sind ferner Dienstboten, Gouvernanten, thörichte Fremde, die theils um sich bei dem Kinde einzuschmeicheln, theils aus einer elenden Sentimentalität, die edel und gutherzig zu sein glaubt, wenn sie Augen verdreht und bedauert, wo nichts, zu bedauern ist,—dem Kinde früh und spät dasselbe Lied vorsingen. Es hört sich nie anders genannt als "armes Kind!" "arme Waise!" Es lernt, dass es eine Unwahrheit sage, so oft es die Stiefmutter "Mama" nenne; es wird zum Spioniren, zur Verstellung angeleitet, man raubt ihm die Offenheit und Unbefangenheit des Kindes und gewöhnt es daran, hinter den Worten der Stiefmutter abweichende Gedanken, hinter ihren Handlungen feindselige Beweggründe zu suchen. MAX NORDAU.

RESULT OF THE FRENCH PRIZE COMPETITION FOR MARCH.

The prize is awarded to "C.E.M.," the pseudonym of Miss Montizambert, The Grove, Dunboyne, Co. Meath.

First Class.—Polly, Myosotis, Dick, Agaznog, Petit oiseau, Kerboga, Raimeis, Yasmar, Esto quod videris, La Printanière, Bonne chance, Korax, Fitzthomas, Dodo, Rustica, Prêtreterre, K.E.Y., Shakspere, Frost, Kalaban, Dum spiro spero, Ashdown, Poulton, Katia, Myope, Beth, Hélène, Wessex, Undine, Day dawn, Dolce far niente, Victor, Toby, Utilitarianism, Phil, Spero (Camelford), Chillon, Chemineau, Maisonette, Nip, Fidessa, Sinbad, Poynton, Scestu, Alcar, Hessary, K.A.M., Marguerite, Ephesian, Cordelia, Pompilia, St. Blaise, Dorothea, Rosalind (Bridge of Allan), Mynwy, Nil desperandum, Wallflower, Iolanthe, Jess, Aquin, En avant, Pollie.

Second Class.—Athene, Eadie, Lady Monica, Opal, Hartley, Verdant, Galtee, Infelice, Watford, B.S.B., Mac, Dido, Débutante, Chaos, March, Charles Darnay, Rossignol, Craigallie, Belle-de-jour, Trellis, Mancroft, Mayflower, Mollibet, Edgewood, Heather Bell, Vincit veritas, Spero (North Shields), Agathos, Dix-sept, Rosalind (West Bromwich), Gwynne, Sheila, Llanroc, Bourne, Freesia, Alcibiades, Servire est regnare, Great Orme, Lily of the Valley, Hopeful, Kirkdale, White Heather, Veronica, Vanity Fair, Lycidas, Pitlessie, Lady Smith.

Third Class.—Une Etudiante, Velsk, Thelma, Landrail, Morganwg, Grey and Gold.

Disqualified.—Rule 2: Defatigatus. Rule 3: Hannah.

Received too late for classification: Aiphos.

Report.

The piece given this month differed much in character from many of its predecessors, and proved a greater difficulty than those given of late months. Too many candidates yielded to the temptation to work into their translations much of what has now become common knowledge respecting the Boers and the questions to which their government of the Transvaal gave rise. For instance, the vast majority translated *peuples arrivés* as "immigrants," whereas it means "highly-civilised nations," or, as some have put it, "up-to-date nations." *Non plus que le stimulant de l'occasion qui va passer* was also the cause of a general failure. It means that with the Boers the incentive to action arising from the necessity of grasping quickly passing opportunities does not exist.

French Prize Translation.

A Boer is quite contented with his life of idleness, provided he can have his coffee, a pipe, and some home-grown tobacco. He lounges in his chair amidst his family, keeping his eye on the road, on the chance of a traveller to gossip with. Everything else he leaves to his quicker-witted wife, who generally does his thinking for him. Time goes for nothing in this easy-going existence, whose sole law is personal convenience, and which lacks the stimulus of the fleeting opportunity. A Boer takes an indefinite time to make up his mind. If he goes on a shooting expedition, he takes his time about it, and half the day is gone before he is ready to start; he stands talking about nothing, and only yields to absolute necessity. Shooting he considers more in the light of a short-cut to Providence's provision warehouse than as a sport. Boers really care for nothing but their cattle. At these they cast loving glances, reckoning and recognising them at evening, when they return from grazing, without ever a mistake. For this is their perambulating fortune, which prospers and multiplies without any trouble, and affords the occasion for those great migrations which Boers love, giving them the wagon as a moving home, involving no alteration in their idle life and habits, and importing variety into the monotony of their existence. If civilisation swoops down upon this rising country, it will do its usual work—destroy its faith and observances, get out of it all it has, and leave it in return the disillusion of successful nations. (Colonel de Villebois Mareuil, *Field Diary.*) C.E.M.

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FOREIGN AND COLONIAL FRENCH PRIZE COMPETITION.

(To be received not later than August 8, 1902.)

L'aspect physique d'Ami vers la quarantaine ne rappelait celui de son père qu'en des proportions réduites et comme faussées; une vilaine bouche, aux lèvres minces, aux dents mauvaises, un nez appointi, un menton fuyant garni d'une barbiche fauve, un aspect tordu qui lui valait son surnom de Barbouchet (Salsifis) donnaient à son visage, un peu dissymétrique, et à toute sa personne, une expression fausse et hargneuse. Cette fois, l'expression ne trompait pas; toujours en querelle avec les voisins ou les clients, le fils Chanteuille passait pour un mauvais coucheur, âpre, rapace, menteur, peu soucieux du choix des moyens pour avancer ses affaires. Peut-être une éducation bien comprise eût-elle amélioré sa nature. Mais son père, qui pourtant y voyait clair, ne comprit jamais par quels moyens on aurait pu le corriger; il le battit comme plâtre dans l'enfance, selon l'adage: "Qui aime bien châtie bien;" ensuite, il le tint sous une dure tutelle, sans lui laisser aucune indépendance, en répétant: "Quand je ne serai plus là, tu feras ce que tu voudras. Moi vivant, il faut marcher droit." Sa plus grande faute fut de refuser toute espèce de satisfaction au besoin impérieux qui dominait son fils: le besoin d'acquérir. Au lieu de le tenir par là, il le chicanait sur les gages d'ouvrier qu'il lui payait, ou sur les parts minimes qu'il lui abandonnait dans les bonnes affaires. EDOUARD ROD.

RESULT OF THE FOREIGN AND COLONIAL COMPETITION.

The prize is awarded to "Malay Peninsula," the pseudonym of Mr. P. Aymar, St. Joseph's Institution, Singapore, Straits Settlements.

First Class.—Diogenes Junior (Victoria), Waldeck (Penang), Hanna (Switzerland), Thildy (Switzerland), Haymaca (Jamaica), Lys d'argent (France), Wauraltie (S. Australia), Essai (Victoria), Eureka (New Zealand), Eicarg (India), Astræa (Victoria), Goburra (N. S. Wales), K.K.K. (N. S. Wales), Sans Dictionnaire (Cape Colony), Irénée (France), A pupil teacher across the seas (N. S. Wales).

Second Class.—Fatima (India), Poensettia (Jamaica), Mathinna (Victoria), Praslin (St. Lucia), Conception Bay (Newfoundland).

Report.

Twenty-two entered for the first Foreign and Colonial Competition. This number is by no means discouraging, and as the fact of the competition becomes better known, we trust to see the number of competitors increase. We have appended to candidates' pseudonyms the places from which their translations have reached us. From this it will be seen that the interval of time we allowed was sufficient to enable readers in our most remote colonies to compete. The translations sent in were, on the whole, of very high merit, and the awarding of the prize was in consequence by no means easy. *Publicité* was the only word over which there was anything like general stumbling. We have set another piece in this competition, translations to be returned by August 8. We trust our readers in the colonies and abroad will do their best to make the competition known among their friends.

Translation.

Like sensibility, physical imagination—I mean the faculty by which the mind pictures to itself sensations—is still lacking in maturity and penetration. This statement partly accounts for the fact that surgical operations are more successful on the Englishman than on the Italian, for instance, because he is more restless and agitated than the former. The *sang froid* of the British Grenadiers under fire, in Spain, at Waterloo, and Inkermann, has been pointed out with admiration by their adversaries—witnesses free from bias. There is no need for them, as there is for Frenchmen, to veil with the bustle of the quick march or the "retreat forward" the vivid images of the whistling bullet, the shattered bones, or the agony caused by the rigid muscular contractions. The visitor who spends a week in London cannot fail to notice the advertising contrivance which consists in a rough and endless reprinting of the same word—of a candidate's name, for instance, placarded a hundred times over vast surfaces. Our more sprightly mind experiences dizziness and loathing at this constant repetition. In England, these strokes a thousand times repeated are all required to drive the idea home through the thick layer which envelops the perceptive organs of the Englishman. Our literary taste is somewhat offended on meeting, in their most appreciated authors, extreme or unnatural types, too highly coloured images, and an irony too strong and sarcastic. MALAY PENINSULA.

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Where held.	Date.	Principal Subjects, etc.	Important Details.
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Greifswald.	July 14–August 4.	German, Latin, French, and English Languages, Literature. Methods of modern language teaching. Phonetics, Pedagogy, Natural Science, History, Geography.	For teachers of both sexes. Special conversation classes for foreigners, on most modern methods. All lectures by University teachers.
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Kiel.....	July 6–26.....	Pedagogy, Psychology, Ethics, History, Natural Science, Language Courses.	For teachers of both sexes. Conversational classes for foreigners, if desired.
Marburg...	1st Course, July 7–27; 2nd Course, August 4–24.	Pedagogy, History of German Language, German Literature, Modern History, History of Art, Phonetics, English and French Literature. Specimen Courses of Modern Language Teaching, New Method.	For teachers of both sexes. Conversation classes (elementary and advanced) for foreigners.
SWITZERLAND:			
Geneva....	July 16–August 28.	French Literature, French institutions, spoken language, rhetoric, style, syntax, methods of teaching.	Specially intended for teachers and advanced foreign students of both sexes.
Lausanne..	July 22–August 30.	Literature, Philology, Phonetics, spoken language, teaching methods. French institutions. History.	For foreigners of both sexes.
Neuchâtel..	1st course, July 15–August 10; 2nd course, August 12–September 7.	General study of French Language and Literature.	For foreigners of both sexes. Elementary and advanced courses.
SPAIN:			
Santander..	August 5–25...	Spanish Language and Literature. Political, social, and economic aspects of the country.	Under management of special committee appointed by the Teachers' Guild.
FRANCE:			
Tours.....	August 1–22...	Literature, History, Language. Political, social, and economic aspects of France.	As above.
Honfleur...	August 1–22...	As above.....	As above.
Paris.....	1st course, July 1–31; 2nd course, Aug. 1–31.	Classical and Modern French Language and Literature, Elocution and Pronunciation. Phonetics. Institutions and Arts of France.	Elementary and advanced courses. Special courses on history of French art and institutions. Conversation classes.
Paris.....	Christmas and Easter Holidays.	Study of French in groups of three or four. Visits to places of interest in Paris; also lectures on Literature, Art, Educational and Social Life of Paris.	Preparatory to summer courses of L'Alliance Française, and to the examination for the certificat d'études françaises de l'université de Paris.
Grenoble...	July 1–October 31.	French Language and Literature. Elocution. Phonetics. Spoken language. History of Art. Political, social, economic aspects of France.	Visits will be made to places of interest in the mountains of Dauphiné. For foreigners of both sexes.
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Brush Drawing. By J. W. Nicol, Bradford. If it were only for the very valuable and common-sense hints given in the text, this book would be exceedingly useful in any school where brush drawing is taught. Mr. Nicol puts his finger on some weak spots which are often found in connection with brush work as taught in elementary schools. Warnings are given against the too long retention of the blob, ill-chosen natural forms, premature design, the total exclusion of the pencil, and other common failings. Teachers should take a careful note of these points; they are of first importance.

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The Training of Teachers and Methods of Instruction. (Selected Papers.) By S. S. Laurie, A.M., LL.D., Professor of the Institutes and History of Education, University of Edinburgh; author of *Primary Instruction in Relation to Education*, etc. With two exceptions, these papers are reprinted from former volumes of essays and addresses now out of print. Intrinsically, every paper here reproduced is well worthy of being thus brought anew under the notice of the public who read educational literature—a public which is not so large as it might be. At the same time, it must be confessed that the appearance of some of the papers at the opening of the twentieth century is a severe, if well-deserved, stricture upon the state of education in England. The papers to which we specially refer are those which advocate and prove the necessity of the training of all teachers. That there should be any need in this year of grace to demonstrate a thesis so nearly axiomatic is little less than an educational scandal. If it is still necessary—and no one is better able to judge than the writer—we cannot imagine any one better fitted than Professor Laurie to drive home the fundamental truths underlying his positions.

We cordially recommend the volume to all readers, whether they are to be classified as unconverted or as already converted to sound doctrine on this point. To consider and appreciate Professor Laurie's opinions on education—in the primary school, the secondary school, and the university—is itself a liberal as well as a professional education for teachers. No living writer is better able to deal with school problems in the light of fundamental truths. Too many educationists confine themselves to the one side or the other, without seeing, or without recognising, the necessary relations between them. Hence arise alike metaphysical subtleties and evanescent fads. In these papers we have the guidance of one who realises the importance of the lowest as well as of the highest stages in education, and who recognises no less the significance of education as a whole in the scheme of individual and social life. We have keenly enjoyed the book, and desire to share our pleasure with many of the brotherhood.

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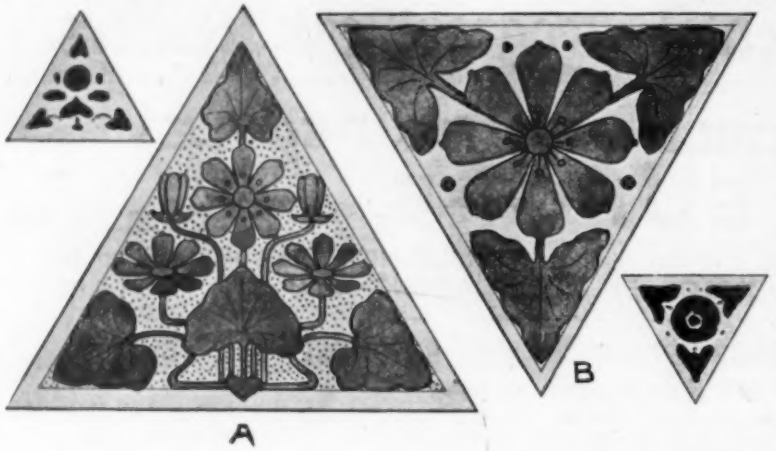

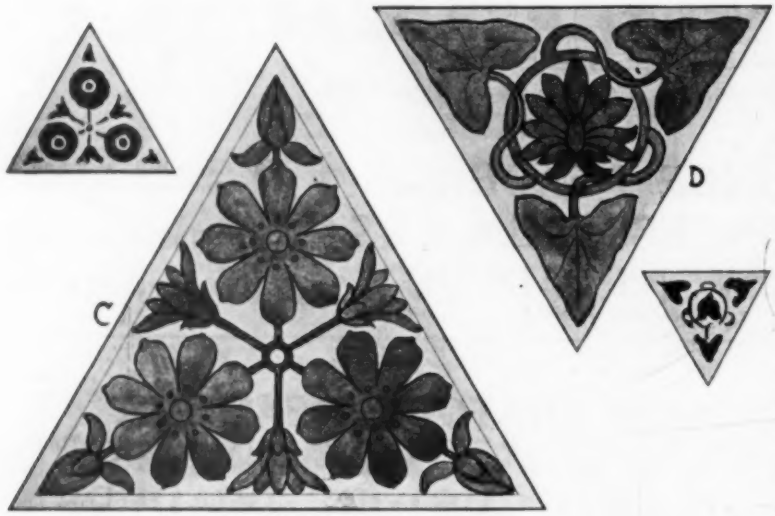

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Geography of Wales. By A. E. L. Hudson, B.A. A very exhaustive little book, well written, and illustrated by diagrams, maps, and pictures. The pictures are for the most part reproductions of photographs, and are therefore thoroughly reliable. As the book is intended chiefly for use in Wales, it is a good thing that the names of places, etc., are given in Welsh as well as English—for example, Barmouth (Abermaw), Dolgelley (Dolgellau). We like the division of the book. Its chapters are written under the headings—1. The Land: its Natural Conditions and Productions; 2. The People: their Manners and their Employments. The counties are described fully and separately.

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